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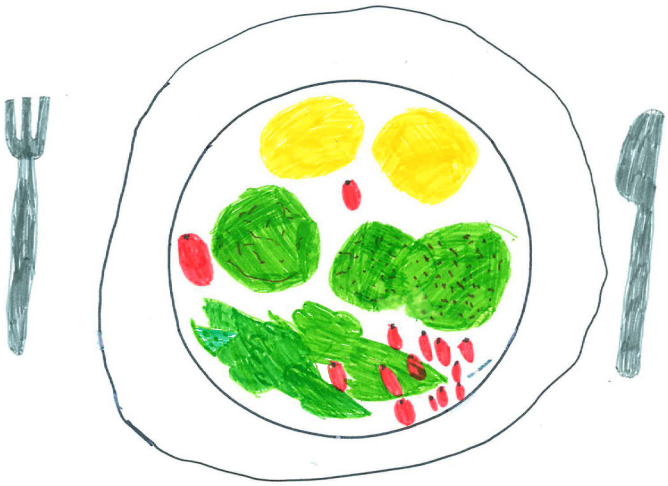
PRESCHOOL AND CHILDREN'S DIETARY INTAKE — THE ROLE OF PRESCHOOL MEALTIME ENVIRONMENT IN CHILDREN'S DIETARY INTAKE AT PRESCHOOL



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PRESCHOOL AND CHILDREN'S DIETARY INTAKE

THE ROLE OF PRESCHOOL MEALTIME ENVIRONMENT IN CHILDREN'S DIETARY INTAKE AT PRESCHOOL

Reetta Lehto

ACADEMIC DISSERTATION

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ABSTRACT

Most under-school-aged children in Western countries attend preschool and eat several meals a day there. Food eaten at preschool thus forms a significant part of their diets. While foods served at preschool self-evidently impact children's dietary intake at preschool, other factors in the mealtime environment may also play a role. Such factors include mealtime practices, such as the serving style of the food, the personnels' role in modelling healthy eating, and encouraging children to try new/less-favourite foods, among others. Additionally, more distal factors in the mealtime environment, such as written food policies and cooperation with catering service, can associate with dietary intake via mealtime practices or food availability. Only a few studies exist on the associations between mealtime environment and children's dietary intake at preschool, so studies in different contexts and on different factors are needed. The use of mealtime practices vary greatly between preschools, so determinants of preschool mealtime practices, such as neighbourhood socioeconomic status (SES), are also of interest.

This study aimed to examine how the preschool mealtime environment, including mealtime practices used by early educators and preschool-level facilitators of and barriers to healthy nutrition, is associated with children's dietary intake at preschool. The examined dietary factors were vegetable consumption, fresh and frozen fruits and berries consumption, fibre intake, energy intake (proportion of daily energy intake at preschool) and added sugar intake. Another aim of the thesis was to assess whether preschool neighbourhood SES associates with mealtime practices in preschool groups.

The thesis applies data from the Increased Health and Wellbeing in Preschools (DAGIS) project. The study data consist of the cross-sectional DAGIS survey conducted in 2015-2016 in eight municipalities in Southern and Western Finland. Of the preschool managers in the participating 66 municipal preschools, 58 (88% of all) reported preschool-level facilitators of and barriers to healthy eating, including food policies, cooking onsite or not, lack of resources, cooperation challenges with catering services, etc. A total of 379 (79%) early educators filled in a questionnaire on their mealtime practices and opinions about preschool food. One early educator in each participating preschool group also reported group-level mealtime practices. Lunch situations of preschool groups were observed by research personnel to assess serving style. Early educators kept food records for the participating children on 2 preschool days. In total, 586 children fulfilled the inclusion criteria of having food consumption data of three meals at preschool on at least one day. Map grid data on preschool neighbourhood SES were received from Statistics Finland.

Sub-study I associated the personnels' positive opinions about preschool food with higher consumption of vegetables among children. In contrast, role

modelling by the personnel and personnels' positive opinion about the preschool food associated with a smaller proportion of daily energy intake at preschool among children. Lastly, encouragement to eat fruits and vegetables (FV) was associated with higher fibre intake. Serving style was not associated with any of the studied dietary intake variables. Sub-study II found that children consumed more vegetables and had a higher fibre intake in preschools belonging to the highest tertile of the number of food policies compared to the lowest tertile. Additionally, manager-reported cooperation challenges with catering service was associated with both higher fibre intake and lower odds of children eating fruits and berries at preschool. Lack of resources (personnel, materials, planning time) was also associated with lower odds of children eating fruits and berries. Other preschool-level factors, such as cooking site, were not associated with children's dietary intake. Sub-study III examined associations between preschool neighbourhood SES and mealtime practices in preschool groups. In the unadjusted model, high preschool neighbourhood SES associated with higher odds of role modelling by the personnel and rewarding with food, and lower odds of birthday treats available at birthdays. However, in the adjusted model, only rewarding with food remained associated with preschool neighbourhood SES.

To conclude, several factors in the preschool mealtime environment were associated with children's dietary intake at preschool. Regarding previous studies, some of the found associations were controversial. When studying associations between mealtime practices and dietary intake, the foods served should also be taken into account. New associations were found not only between the personnels' opinions about the food and children's dietary intake but also between cooperation challenges with catering service and children's dietary intake. These findings, especially cooperation between preschool and catering personnel, should be studied further and more thoroughly. All in all, the preschool mealtime environment can partly determine children's dietary intake at preschool, and these factors should be acknowledged when promoting healthy food intake at preschool.

TIIVISTELMÄ

Länsimaissa suurin osa alle kouluikäisistä lapsista käy päiväkodissa ja syö siellä useita aterioita päivittäin. Päiväkodissa syöty ruoka muodostaa siten merkittävän osan heidän ruokavaliostaan. Vaikka on selvää, että päiväkodissa tarjolla oleva ruoka määrittää lasten ruuankäyttöä päiväkotipäivien aikana, myös ruokailuympäristöllä voi olla merkitystä sille, mitä ja kuinka paljon lapset syövät päiväkodissa. Tällaisia tekijöitä ovat esimerkiksi ruokailukäytännöt, joihin sisältyy muun muassa ruoan tarjoilutapa, henkilöstön ruokailu lasten kanssa ja rohkaisu kokeilla uusia tai vähemmän suosittuja ruokia. Lisäksi ruokailuympäristön kaukaisemmat tekijät, kuten ruokailuun liittyvät kirjalliset säännöt ja yhteistyön toimivuus ruokapalvelun kanssa, voivat olla yhteydessä lasten ruoankäyttöön ruokailukäytäntöjen tai tarjolla olevan ruoan kautta. Ruokailuympäristön ja lasten ruoankäytön välisistä yhteyksistä päiväkodissa on vain vähän tutkimuksia, ja lisätutkimuksia tarvitaan erilaisista konteksteista ja ruokailuympäristön osatekijöistä. Lisäksi päiväkotien osin epäyhteneväisiä ruokailukäytäntöjä määrittäviä tekijöitä on tärkeää selvittää.

Tämän väitöstutkimuksen tarkoituksena oli selvittää, miten päiväkodin ruokailuympäristö, mukaan lukien varhaiskasvattajien käyttämät ruokailukäytännöt sekä päiväkotitason tekijät ovat yhteydessä lasten ruoankäyttöön ja ravinnonsaantiin päiväkodissa. Tutkittuja ravintotekijöitä olivat kasvisten kulutus, tuoreiden ja pakastettujen hedelmien ja marjojen kulutus, kuidun saanti, energian saanti (päiväkotiaikaisen energiansaannin osuus koko päivän energiansaannista) ja lisätyn sokerin saanti. Väitöstutkimuksen tavoitteena oli myös arvioida, onko päiväkodin alueen sosioekonominen asema yhteydessä päiväkotiryhmissä käytettyihin ruokailukäytäntöihin.

Väitöskirjatyössä käytetään Increased Health and Wellbeing in Preschools (DAGIS) –hankkeen tutkimusaineistoa. Tutkimusdata koostuu DAGIS-hankkeen poikkileikkaustutkimuksen aineistosta, joka kerättiin vuosina 2015-2016 kahdeksassa kunnassa Uudellamaalla ja Etelä-Pohjanmaalla. Tutkimukseen osallistuneiden 66 päiväkodin johtajista 58 (88 %) täytti kyselylomakkeen päiväkotitason tekijöistä, jotka voivat olla terveellisen ruoankäytön edistäjiä tai esteitä: ruokaan liittyvät kirjalliset säännöt, ruoan valmistuspaikka, käytettävissä olevat resurssit sekä yhteistyö ruokapalvelun kanssa. Kaikkiaan 379 (79 %) varhaiskasvattajaa täytti kyselylomakkeen ruokailukäytännöistään ja päiväkotiruokaan liittyvistä mielipiteistään. Lisäksi yksi varhaiskasvattaja jokaisesta osallistuvasta päiväkotiryhmästä raportoi ryhmätason ruokailukäytäntöjä. Lisäksi tutkijat havainnoivat päiväkotiryhmien lounastilanteita. Varhaiskasvattajat pitivät ruokapäiväkirjaa tutkimukseen osallistuvien lasten ruoankäytöstä kahtena päiväkotipäivänä. Kaikkiaan 586 lasta oli syönyt kolme ateriaa päiväkodissa

ainakin toisena kirjanpitopäivänä, ja heidät otettiin mukaan analyyseihin. Tilastokeskukselta saatiin tiedot päiväkotien alueiden asukkaiden sosioekonomisesta asemasta.

Osatutkimuksessa I varhaiskasvattajien positiiviset mielipiteet päiväkotiruoasta olivat yhteydessä lasten runsaampaan kasvisten kulutukseen. Sitä vastoin henkilöstön lounastaminen lasten kanssa ja positiivinen mielipide päiväkotiruoasta olivat yhteydessä vähäisempään energiansaantiin päiväkodissa. Kannustaminen kasvisten ja hedelmien syömiseen oli yhteydessä runsaampaan kuidun saantiin. Ruoan tarjoilutyyli ei ollut yhteydessä mihinkään tutkituista ravintotekijöistä. Osatutkimuksessa II havaittiin, että lapset söivät enemmän kasviksia ja saivat enemmän kuitua päiväkodeissa, joissa oli eniten ruokailuun liittyviä kirjallisia sääntöjä. Lisäksi päiväkodin johtajan raportoimat yhteistyöhaasteet ruokapalvelun kanssa olivat yhteydessä sekä lasten runsaampaan kuidun saantiin että pienempään todennäköisyyteen syödä hedelmiä ja marjoja. Myös resurssien (suunnitteluajan, henkilökunnan ja materiaalien) puute oli yhteydessä pienempään todennäköisyyteen, että lapset söivät hedelmiä ja marjoja. Muut päiväkotitason tekijät, kuten ruuanvalmistuspaikka, eivät olleet yhteydessä lasten ruoankäyttöön. Osatutkimuksessa III tutkittiin alueen sosioekonomisen aseman ja päiväkotiryhmien ruokailukäytäntöjen yhteyksiä. Vakioimattomassa mallissa alueen korkea sosioekonominen asema oli yhteydessä suurempaan todennäköisyyteen, että henkilökunta söi samaa ruokaa kuin lapset, että syntymäpäivätarjoiluja ei ollut saatavilla ja että varhaiskasvattajat käyttivät ruokaa palkitsemiseen. Vakioidussa mallissa vain yhteys ruoan käyttämiseen palkintona pysyi merkitsevänä.

Yhteenvetona voidaan todeta, että monet tekijät päiväkodin ruokailuympäristössä olivat yhteydessä lasten ruoankäyttöön päiväkotipäivän aikana. Havaitut yhteydet olivat osin ristiriidassa aikaisempien tutkimustulosten kanssa. Tutkittaessa ruokailuympäristön ja ruoankäytön välisiä yhteyksiä myös tarjolla olevat ruoat olisi otettava huomioon. Tutkimus tuotti uutta näyttöä henkilöstön mielipiteiden ja lasten ruoankäytön sekä eri toimijoiden välisten yhteistyöhaasteiden ja lasten ruoankäytön välillä. Etenkin päiväkodin ja ruokapalvelun yhteistyötä ja sen haasteita tulisi tulevaisuudessa tutkia kattavammin. Päiväkodin ruokailuympäristö määrittää osaltaan lasten ruoankäyttöä päiväkodissa ja sen osatekijät tulisi ottaa paremmin huomioon pyrittäessä edistämään lasten terveellisiä ruokailutottumuksia päiväkodissa.

SAMMANDRAG

I västländer deltar de flesta barn i daghemsverksamhet och de äter flera måltider per dag på daghemmet. Mat som äts på daghem utgör därmed en betydande del av deras kostintag. Även om mat som serveras på daghem självklart påverkar barns kostintag, så kan andra faktorer i måltidsmiljön också spela en roll för kostintaget. Sådana faktorer är t.ex. måltidpraxis, som inkluderar bland annat servering av maten, om personalen äter samma mat tillsammans med barnen och uppmuntran att pröva ny mat /mindre favoritmat. Dessutom kan mer distala faktorer i måltidsmiljön, såsom skriftliga regler om mat eller samarbete med daghemmets cateringtjänst ha samband med barns kostintag via måltidspraxis eller mattillgänglighet. Det finns få studier om samband mellan måltidsmiljö och barns kostintag på daghem, få studier i olika daghemskontexter och om olika faktorers inverkan och därförbehövs dessa studier. Eftersom användningen av måltidspraxis varierar kraftigt mellan daghem, så är dessutom faktorer som bestämmer måltidspraxis av betydelse. En sådan faktor kan vara områdets socioekonomiska status (SES).

Syftet med denna doktorsavhandling var att undersöka hur daghemmets måltidsmiljö, inklusive måltidspraxis av daghemspersonalen och matrelaterade faktorer på daghemsnivå, har samband med barns kostintag på daghem. Det undersökta kostintaget var konsumtion av grönsaker, färsk frukt och färsk eller frusen bär, fiberintag, energiintag (andel energiintag under daghemstid) och intag av tillsatt socker. Ett annat syfte med avhandlingen var att undersöka om områdets SES har samband med personalens måltidspraxis. Avhandlingen använder data från forskningsprojektet Increased Health and Wellbeing in Preschools (DAGIS). Studiedata i denna avhandling härstammar från DAGIS tvärsnittsundersökning som genomfördes 2015-2016 i åtta kommuner på 66 kommunala daghem i södra och västra Finland. Daghemschefer från 58 daghem (88%) rapporterade kostelaterade faktorer på daghemsnivå, inklusive skriftliga matrelaterade regler, om maten lagas på plats eller inte, brist på resurser, och samarbetsutmaningar med cateringtjänst. Totalt fyllde 379 (79%) personer ur daghemspersonalen i ett frågeformulär om sin måltidspraxis och sina åsikter om daghemsmaten. Dessutom rapporterade en pedagog, i varje deltagande daghemsgrupp, måltidspraxis på gruppnivå. Forskare observerade lunchsituationerna idaghemsgrupperna för att utvärdera serveringsstil. Daghemspersonalen förde kostdagbok för de deltagande barnen under två daghemsdagar. Totalt uppfyllde 586 barn inkluderingskriterierna, dvs att ha kostdata från daghemmet för tre måltider under minst en daghemsdag. Statistikcentralen i Finland levererade data om den socioekonomiska statusen bland befolkningen i daghemsområdet.

I delstudie I hade personalens positiva åsikter om daghemsmaten samband med högre intag av grönsaker bland barn. Däremot hade det att personalen åt samma mat som barn och personalens positiva åsikt om daghemsmat samband med mindre andel av energiintaget under tiden som man vistades på daghem. Slutligen hade uppmuntran att äta frukt och grönsaker samband med högre intag av fiber. Serveringsstil hade inte samband med det undersökta kostintaget. I delstudie II konstaterades att barn konsumerade mer grönsaker och hade högre intag av fiber i daghem som tillhör den högsta tertilen i antalet skriftliga regler gällande mat jämfört med den lägsta tertilen. Dessutom hade utmaningar i samarabetet med cateringtjänsten samband med både högre fiberintag och lägre sannolikhet för att barn äter frukt på daghem. Andra faktorer på daghemsnivå, till exempel matlagning på plats eller inte, matpedagogik och brist på resurser hade inte samband med barns kostintag. I delstudie III undersöktes samband mellan områdets SES och måltidspraxis i daghemsgrupper. I de okorrigerade analyserna fanns det ett samband mellan områdets högre SES och en större sannolikhet att personalen äter med barnen, att personalen belönar med mat och en mindre sannolikhet att det serveras också annan mat under födelsedagar. I de korrigerade analyserna kvarstod resultatet att personalen belönar med mat som signifikant.

Avslutningsvis, flera faktorer i daghemmets måltidsmiljö hade samband med barns kostintag på daghemmet. Jämfört med tidigare undersökningar var några av de funna sambanden kontroversiella. När man studerar samband mellan måltidsmiljö och kostintag på daghem, bör även mat som serveras beaktas. Studien visade på nya samband såsom samband mellan personalens åsikter om maten och barnens kostintag, och utmaningar i samarbete med cateringtjänsten och barnens kostintag. Dessa resultat, särskilt samarbetet mellan daghemspersonal och cateringpersonal, bör studeras ytterligare och mer ingående. Sammantaget kan måltidsmiljön delvis bestämma barns kostintag på daghem och dessa måltidsmiljöfaktorer bör beaktas när man främjar ett hälsosamt kostintag på daghem.

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The DAGIS study is a large project that was and is being conducted by a large group of people, all of whom were needed to collect and analyse the vast datasets. It would not have been possible to make this thesis without the DAGIS study and all of its participants, researchers and other personnel. For that reason, I want to thank all current and former members of the DAGIS study group. I also want to thank all the parents, children and preschool personnel who helped us with the data collection and gave us the information we asked for. I especially thank the leader of the DAGIS consortium, my boss, Adjunct Professor Eva Roos, who has led the project with great expertise, common sense, and a warm heart. Eva has also had an important role in my other tasks at Folkhälsan and in DAGIS study. She has guided me, believed in me, and helped me with her wise considerations numerous times. I am also grateful to Maikki's DAGIS research group at Viikki, Henna Vepsäläinen, Liisa Korkalo, and Essi Skaffari, who have helped me numerous times with the dietary intake data. I also appreciate all other co-authors in my thesis articles, Kaija Nissinen, Suvi Määttä, Leena Koivusilta, Elviira Lehto, Mari Saha (former Nislin), Hanna Konttinen and Riikka Kaukonen, for their wise, sharp-eyed and challenging comments and questions. I also thank Rejane Figueiredo for kindly helping me with the statistical analyses. In addition to working together, it has been a great joy to spend time with the DAGIS group at the group's numerous social events!

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CONTENTS

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following publications:

I **Lehto R**, Ray C, Vepsäläinen H, Korkalo L, Nissinen K, Skaffari E, Määttä S, Roos E, Erkkola M. Early educators' practices and opinions in relation to pre-schoolers' dietary intake at pre-school: case Finland. Public Health Nutrition 2019:22:1567-1575. doi: 10.1017/S1368980019000077.

II **Lehto R**, Ray C, Korkalo L, Vepsäläinen H, Nissinen K, Koivusilta L, Roos E, Erkkola M. Fruit, Vegetable, and Fibre Intake among Finnish Preschoolers in Relation to Preschool-Level Facilitators and Barriers to Healthy Nutrition. Nutrients 2019:11 pii:E1458. doi: 10.3390/nu11071458.

III **Lehto R**, Lehto E, Konttinen H, Vepsäläinen H, Nislin M, Nissinen K, Vepsäläinen C, Koivusilta L, Erkkola M, Roos E, Ray C. Neighborhood Socioeconomic Status and Feeding Practices in Finnish preschools. Scand J Public Health 2019:47:548-556. doi: 10.1177/1403494819832114.

The publications are referred to in the text by their roman numerals.

ABBREVIATIONS

CACFP	Child and Adult Care Food Program
DAGIS	Increased Health and Wellbeing in Preschool -Study
ECEC	Early childhood education and care
EPAO	Environmental Policy Assessment and Observation
EBRB	Energy balance-related behaviour
FV	Fruits and vegetables
HEI	Healthy Eating Index
OR	Odds ratio
PUFA	Polyunsaturated fatty acids
SAFA	Saturated fatty acids
SD	Standard deviation
SES	Socioeconomic status

1 INTRODUCTION

Preschool meals are an important and self-evident part of early childhood education and care in Finland, because preschools provide children all food eaten during the preschool hours. Preschool meals, together with free and universal school lunch for all Finnish school children since the 1940's, have created a long history of free institutional catering for children in Finland, which is exceptional worldwide [1]. Still, surprisingly little research has been conducted on children's mealtimes and dietary intake in Finnish preschools.

The earliest preschools in Finland date back to the end of the 19th century, and right from the start preschools started to offer the children one meal a day. This was seen important, because many children attending preschools were weak and not in good physical health. [2] The first Finnish law on preschool (laki lasten päivähoidosta 19.1.1973) was passed in 1973 [3]. Food was not mentioned in that law, but in 1985 it was added that children attending preschools should must be provided with food that fulfills their nutritional needs. The current law also states that meal situations must be guided and organised in appropriate way. The first specific nutrition recommendations for children in Finland were published in 1989 [4], and they included a section on preschool meals and food. The recommendations included recommendations not only for the intake of specific nutrients but also for the organisation of meals and food education for children.

Recommendations for preschool food and meals have changed during the making of this doctoral thesis. When the data were collected in 2015 and 2016, the valid recommendations were Hasunen et al.'s *Lapsi, perhe ja ruoka. Imeväis- ja leikki-ikäisten lasten, odottavien ja imettävien äitien ravitsemussuositus* from 2004 [5]. The recommendations included a short chapter on food and organisation of meals in early childhood education and care settings. The update of the children's nutrition recommendation, *Eating together – food recommendations for families with children,* was published in 2016 [6], and it also included a section on preschool food and mealtime arrangements. In 2018, the first food recommendation solely for early childhood education and care settings, *Health and joy from food - meal recommendations for early childhood education and care,* was published by the National Institute for Health and Welfare [7]. These recommendations put much emphasis on food education, which is seen as any activity related to food and eating and which is delivered both at mealtimes and included in other daily activities. In addition to nutritional recommendations, the recommendation emphasises enjoyment of food, children's involvement, and a positive attitude towards food and eating.

Early childhood is a critical period for the development of food preferences [8], and health behaviours adopted in childhood often track into adulthood [9, 10]. Thus, food consumption and eating habits in early childhood play an

important role in later eating habits. The present-day obesogenic food environment is challenging for children and families [11, 12], and children's overweight and obesity continue to be at a very high level [13]. Thus, preschool could have an important role in promotion of healthy eating habits, other health behaviours and healthy growth. Municipal preschools in Finland are especially potential, because the large majority of young children attend municipal preschools [14]. This also enables municipal preschools to diminish socioeconomic differences in children's dietary intake, which exist already in this age group [15].

In this thesis, I examine the associations between preschool mealtime practices and other mealtime environmental factors and children's dietary intake at preschool, and, additionally, preschool neighbourhood socioeconomic status. I examined in sub-study I how mealtime practices and early educators' opinions were associated with children's dietary intake at preschool. Sub-study II assessed preschool-level factors, such as food policies and manager's opinions and attitudes in relation to children's dietary intake. I examined in sub-study III whether preschool neighbourhood socioeconomic status was associated with mealtime practices in preschool groups. Preschool food availability and foods served are not studied. The thesis is part of the Finnish DAGIS study that examines preschoolers' health behaviours and stress and their determinants, both at home and at preschool.

Next, in the literature review, I will present socioecological models as a framework to study the effects of environmental factors on children's dietary intake. Then, I present previous studies on children's dietary intake at preschool, following with the presentation of studies examining the mealtime environment at preschool. I also present neighbourhood socioeconomic status as a determinant of preschool mealtime practices. Lastly, I will present studies that have examined associations between mealtime environment and children's dietary intake at preschool.

2 REVIEW OF THE LITERATURE

2.1 SOCIOECOLOGICAL MODEL OF FOOD INTAKE

Many personal, social, and other environmental factors are important as determinants of food intake [16]. One theoretical framework for examining determinants of food intake, or any other health behaviour, is an ecological model. It is useful especially when other than personal determinants of health behaviour are assessed, as it emphasises that multiple environmental factors on different levels can impact an individual's health behaviour [16, 17]. Ecological models emphasise environmental and policy contexts of behaviour and consider multiple levels that affect health behaviour [17]. These levels usually include an intrapersonal level for personal characteristics, an interpersonal level that includes social influences, an organisational level, for example, school or workplace, and community and societal levels (Figure 1). Ecological models are also referred to as social ecological models or socioecological models. This study uses the term socioecological model.

A key principle in socioecological models is the interaction within and across the levels, meaning that the variables in one level and on different levels work together to shape an individual's health behaviours. For example, the physical environment at school (food availability) can affect an individual's food consumption differently depending on social effects [17]. Socioecological models can be and are often used to develop multi-level health promotion interventions and to study the effects of several environmental factors on a health behaviour. Socioecological levels are behaviour specific, because environmental and policy variables often are specific for one health behaviour. A weakness of socioecological models is their lack of specificity. Socioecological models do not identify specific variables or mechanisms important for a specific health behaviour; rather, they create an overwiev of what types of variables should be taken into account.

Children's food intake in general [18], and especially at preschool [19], is largely affected by both social and physical environmental factors. At preschools where the preschool provides the food, children have very little influence on food availability and mealtime arrangements, both of which can be influenced by multiple environmental and policy factors. Thus, a socioecological model may be a very useful framework for examining factors associated with children's food intake in such setting. This thesis uses the socioecological model as a framework to examine how different factors are associated with children's dietary intake and preschool mealtime practices.

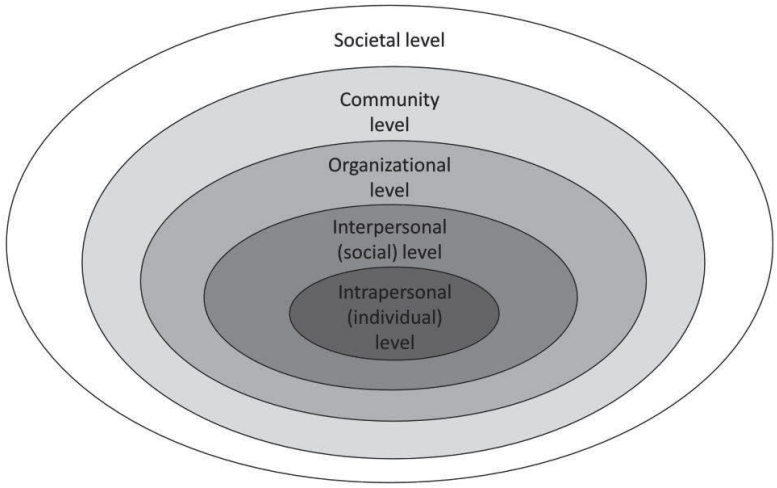


Figure 1. A socioecological model. Adapted from Bronfenbrenner, U. 1979. [20].

2.2 CHILDREN'S DIETARY INTAKE AT PRESCHOOL

I use the term preschool in this thesis to describe any centre-based early childhood education and care (ECEC) settings. Other terms referring to the same type of care can be called childcare center, daycare center or kindergarten.

The proportion of children attending preschool and the number of meals they eat at preschool per week is worth consideration to understand the importance of children's food intake at preschool. Formal childcare attendance rates are mostly very high in Western countries, being on average 89% among 4-year-olds in EU countries [21]. The attendance rate among 4-year-olds in Finland was 85% in 2018 [14]. The weekly time spent at preschool, and thus the number of meals eaten at preschool, varies greatly in Europe: In some countries, such as the Netherlands, almost all children attend under 30 h per week, while in others it is the opposite [22]. The large majority of children in Finland are in full-time care [14], meaning that children eat 2-3 meals per day at preschool five days a week. Thus, food eaten at preschool forms a substantial part of their diet [6, 7].

Finnish preschools serve children 3 meals a day: a breakfast, lunch and afternoon snack. No food is brought from home. Internationally, there is variation in the content and timing of the meals and snacks and whether the food is provided by the preschool, brought from home, or a mixture of these [23-25]. I concentrate on foods served by the preschool and children's dietary intake from these foods in this literature review. Studies on foods brought from home are not included. Scientific publications on children's dietary intake at preschool mainly originate from the USA and some other Western

countries. Only studies published after 2000 were included, because of potential changes in preschool food over the decades.

2.2.1 FINNISH RECOMMENDATIONS FOR CHILDREN'S DIETARY INTAKE AT PRESCHOOL

The Finnish food recommendations for families with children and meal recommendations for early childhood education and care state food and nutrient intake recommendations for children in general [6] and specifically for preschool [7]. This thesis examined the following foods and nutrients: fruits and vegetables (FV) consumption, energy intake, fibre intake and added sugar intake, which all have specific recommendations in the aforementioned publications. The energy intake of children in full-time care at preschool is recommended to cover two thirds of a child's daily energy needs and vary between 3,3 and 4,6 MJ depending on a child's age [7]. The fibre intake recommendation for children is expressed as fibre density and should be 2-3 g/MJ. The intake of added sugar should not exceed 10 E%. Five handfuls (about 250 g) of FV in total are recommended as daily consumption. [6] The preschool meal recommendation states that each meal should contain at least one portion of fruits, vegetables or berries [7].

2.2.2 CHILDREN'S DIETARY INTAKE AT PRESCHOOLS OUTSIDE FINLAND

Table 1 presents studies that have assessed children's dietary intake or foods served at preschool and their main results. Several articles in the USA have published findings on children's dietary intake at preschools [26-31]. The studies' methods vary, but in most of them, research personnel have observed what and how much the children have eaten [26, 27, 29, 30]. Copeland et al. [28] studied only preschool menus. The sample sizes of these studies have been quite small, ranging from 50 to 240, with the exception of Andreyeva et al. [31], and they have compared children's food consumption to the following US recommendations: MyPyramid food group recommendations [29], Food Guide Pyramid for Young Children [30], Healthy Eating Index 2005 [26] or Child and Adult Care Food Program (CACFP) recommendations [26, 31, 32]. Consumption of foods is mainly described as numbers of servings. Despite the studies' small sizes, varied geographical locations and different methods, all of the studies concluded that the intake (or serving) of vegetables is too low compared to the recommendations. Studies also concluded that consumption/serving of whole grains or fibre [26, 29-31] and whole fruits [28-30] is too low and intake of added/saturated fats and sugar too high [28, 29, 31]. Consumption of dairy was mostly sufficient [26, 29-31], but milk was mainly high in fat [28, 29]. Sisson et al. reported differences between preschool lunches and home dinners among 3-5-year-olds in the US [33] and concluded that children ate more nutrient-dense foods and more FV at

preschool, whereas at home children consume more high fat, high sugar foods and sugary drinks.

A Canadian study with a representative sample of preschools in two Canadian provinces has reported the amounts of foods served [34] and the dietary intakes in Canadian preschools at lunch [35]. Although a more recent study than most of its US counterparts, the results show similarly that, compared to recommendations, too few FV are served and eaten, and fibre intake is low. Additionally, the amount of the foods served overall was little [34]. An Australian study that had assessed preschool menus concluded that a high proportion of preschools served foods in line with Australian recommendations for most food groups [36]. Still, none of the preschools served enough vegetables compared to the recommendations. Unlike other studies, Er et al. [37] reported that 2-4-year-old English children consumed high amounts of FV while at nursery. They also stated that the finding might be due to the dietary assesment method overestimating the amount of food eaten. A child who had eaten a mouthful of food was considered to have eaten a portion. In the same study, the children were also reported to eat high amounts of high sugar and high fat snacks.

Gubbels et al. have reported toddlers' (1-4-year-olds') dietary intake in Dutch preschools in two separate studies [25, 38]. In both studies they conclude that children eat high amounts of fruits, and low amounts of vegetables at preschool. Intake of sugar was not reported, but in 2015, Gubbels reported children drinking high amounts of sweet drinks [25]. A Polish study reported high intake of saturated fat and sucrose among 4-6-year-old preschoolers in Poland [39]. In a relatively old study from Sweden, Sepp et al. [40] reported 4-6-year-old children's (n=131) nutrient intakes at preschool measured by 5-day weighed food records. The intake of sugar at preschool was below the recommended maximum intake and lower at preschool than at home in this study, while riber intake was higher at preschool than at home. Consumption of vegetables or fruits were not reported.

2.2.3 CHILDREN'S DIETARY INTAKE AT PRESCHOOL IN FINLAND

There is only one published study in Finland of children's dietary intake at preschool after 2000. Lehtisalo et al. have compared the total daily dietary intake of 3-year-old children cared for at home and in daycare outside the home [41]. Children cared for outside the home were more often consumers of recommended foods, such as vegetables, fruits, berries, fish, margarines and rye bread. Their sugar intake was also lower than that of those cared for at home. The findings do not merely apply to food eaten at preschool, because the results refer to whole-day dietary intake. But, as the authors stated, since no differences between the two groups were found on those weekdays when all meals were eaten at home, the differences must be due to food eaten while in daycare.

Table 1. *Studies reporting children's dietary intake or foods served at preschool.*

First author, year, and study country	Number of study participants	Age of the children	Dietary assessment method	Main results
Sisson 2017, USA	90	3–5 years	Observation by research personnel at preschool on 2 lunches, parents filled in food records at home for 3 dinners	Compared to dietary intake at home, more fruits, vegetables and low-fat dairy and less high fat and high sugar foods and sugary drinks were consumed at preschool.
Erinosho 2013, USA	120	3–5 years	Observation of foods served to children by research personnel on 2 days	The findings were compared to HEI-2005. Good scores were met for fruits and sodium. Mean scores for vegetables, grains and whole grains, oils and meat/beans were low. Scores for saturated fat and added sugar suggest a need to decrease these.
Erinosho 2011, USA	240	3–4 years	Observation by research personnel on 1 day between 8–14 o'clock.	Consumption of vegetables and vitamin E containing foods is low. Availability of drinking water is not optimal.
Copeland 2013, USA	258 preschools	-	Assessment of menus of the previous month	Serving of vegetables and whole fruits is low, and sweet and salty snacks is high especially at snacks.
Ball 2008, USA	117	2–5 years	Observation by research personnel on 2 days	Compared to MyPyramid food group recommendations, children consumed too little whole grains, vegetables and fruits, and too much saturated fat and added sugar.
Padget 2005, USA	50	3–5 years	Observation by research personnel on 3 days	Compared to the recommendations of the Food Guide Pyramid for Young Children, children consumed insufficient amounts of vegetables and grains.

Andreyeva 2018, USA	838	-	Observation and plate waste measurement by research personnel on 1 lunch	Compared to CACFP recommendations, children consumed little energy, little fibre, too much SAFA[3], and little fruit and vegetables at lunch.
Ward 2017, Canada	61 preschools	-	Weighing and photographing of foods served to children by research personnel at lunch on 2 days	Compared to provincial recommendations, the served lunches were low in all food groups (fruits, vegetables, fluid milk, milk and alternatives, meat and alternatives) except grains.
Yoong 2014, Australia	46 preschools	-	Assessment of 2-week preschool menu plans	Most preschools serve foods in line with Australian recommendations for most food groups excluding vegetables.
Er 2018, UK	150	2–4	Observation and a tick list questionnaire (Child and Diet Evaluation Tool (CADET)) filled by research personnel	High intake of FV and other food groups, including high fat and high sugar snacks.
Gubbels 2014, The Netherlands	1016	1–3 years	Precoded 2-day food record kept by preschool personnel	Compared to dietary intake at home, children consumed more carbohydrates and less protein and fat at preschool. Consumption of FV could be increased at preschool.
Gubbels 2015, The Netherlands	398	1–4 years	Precoded 2-day food record kept by preschool personnel	High intake of fruits and sweet drinks, low intake of vegetables
Merkiel 2016, Poland	128	4–6 years	5-day weighed food record kept by preschool personnel	High intake of SAFA and sucrose, low intake of PUFA. Inadequate intake of fibre and many vitamins.

Sepp 2001, Sweden	131	3–5 years	5-day weighed food record kept by preschool personnel	Compared to dietary intake at home the intake of sugar at preschool was lower and intake of fibre was higher at preschool.
Lehtisalo 2010, Finland	471	3 years	3-day food record kept by preschool personnel at preschool and parents at home	Compared to children cared for at home, the consumption of vegetables, fruits, berries, fish, rye bread and margarine was higher and intake of sucrose was lower among the children who were cared for outside the home.

HEI-2005 Healthy Eating Index 2005, a measure of diet quality based on recommendations of the 2005 American Dietary Guidelines
CACFP Child and Adult Care Food Program
FV fruits and vegetables
SAFA saturated fatty acids
PUFA polyunsaturated fatty acids

2.3 PRESCHOOL MEALTIME ENVIRONMENT

Many different terms are used to describe the physical and social preschool environment, concerning food, meals, and eating [24, 42-44]. I use the term *mealtime environment* in this thesis to describe any factors that relate to food and eating at preschool, although excluding food availability, which is not studied in this thesis. Other similar terms include nutrition environment, food environment (mostly referring to food availability and accessibility), and feeding environment.

Two distinct levels can be formed when using a socioecological model to structure factors in the preschool mealtime environment. The preschool group level is the closest level to the child, and factors are situated at that level that are in the immediate surroundings of the children and present at mealtimes. Such factors include mealtime practices and other factors concerning personnel. More distal preschool-level factors are factors not directly present at mealtimes, such as preschool food policies.

2.3.1 PRESCHOOL MEALTIME PRACTICES

Mealtime practices are a specific group of factors that come under the concept of mealtime environment. Mealtime practices describe the practices and actions that organise how mealtimes are managed and what the personnel and the children do at mealtimes. Synonyms for mealtime practices are feeding practices, food practices and nutrition practices. The term feeding practice has been commonly used and was originally used to describe how parents feed their child. It is closely related to the term parental feeding style, which classifies parents' style of feeding their child, such as emotional feeding, control over eating, instrumental feeding and prompting/encouragement to eat [45]. Parental feeding practices mean different things depending on a child's age, but among preschool-aged children, parental feeding practices can mean such things as parental use of restriction or control, monitoring, encouraging, using food as a reward or punishment, parental modeling of healthy eating, or allowing children control over feeding [46-48]. The reason for the interest in parental feeding practices is that they are thought and found to be associated with children's eating behaviours and weight-related matters [49-51].

Mealtime practices at preschool is a relatively new research topic. Such mealtime practices cover matters partly similar to parental feeding practices, as well as other practices specific to institutional catering and children eating in a group setting [52], such as serving style (how the foods are served). Unlike parents, early educators are also bounded/affected by preschool policies,

regulations and practices, which greatly determine how mealtimes are handled [32, 53].

Recommendations on preschool mealtime practices

National and other recommendations on preschool food often include recommendations on mealtime practices. These include the US recommendations, *Position of the American Dietetic Association: Benchmarks for nutrition in child care* [54] and *Caring for Our Children: National Health and Safety Performance Standards: Guidelines for Early Care and Education Programs* [55] and the UK recommendations *Eat Better, Start Better Voluntary Food and Drink Guidelines for Early Years Settings in England – A Practical Guide* [56]. The Finnish recommendations, *Health and joy from food - meal recommendations for early childhood educatio*n *and care,* also include recommendations on the mealtime environment [7].

The US recommendations suggest letting children serve themselves, personnel sitting with the children and eating the same food as children, talking about healthy foods with children, encouraging children to try new/less favourite foods, helping children to recognize internal hunger/satiety cues by asking them about feeling hungry/full, and letting children decide how much they eat [54, 55]. Controlling mealtime practices (e.g., pressuring children to eat) and instrumental feeding (e.g., using food to reward or punish) should be avoided.

The Finnish recommendations stress that mealtimes are part of the pedagogic activities at preschool and that meals are learning situations [7]. The term food education is used to describe any food-related activities at preschool and practices at mealtimes. They state that meal situations should be positive and enjoyable, that children should be actively involved in the chores concerning meals and that early educators should discuss foods with children and encourage them to try new foods. Recommendations specific to mealtimes state that early educators should eat with children as an example (role modelling), children should be allowed to self-serve (family style serving), and their expressions of hunger and satiety should be respected; thus, for example, children should not be pressured to eat nor should food be used as a reward or punishment.

The recommendations are made to promote healthy dietary intake, eating behaviours and growth among children [7, 53]. Recommendations on mealtime practices are mostly based on expert opinion and experimental studies [54]. Some mealtime practices are recommended, even though the evidence of their benefits is not yet convincing: for example, the recommendation on role modelling by personnel is only based on two small experimental studies [57, 58], but role modelling is still considered important [7, 54]. Self-serving and respecting children's feelings of hunger and satiety are recommended, because they are seen as important for children's self-

regulation skills and regulation of energy intake [59, 60]. Pressuring children to eat is discouraged, because it can cause dislike for the foods that the child was pressured to eat [61, 62]. Similarly, rewarding with food or using other rewards for eating is discouraged for their negative effects on liking of the food, although rewarding might also help to get children to try new foods [63-65].

Measurement of preschool mealtime practices

The differences between mealtimes at home and at preschool mean that assessment methods specific to preschool setting are needed [52]. Many preschool studies have used modified versions of questionnaires designed for the assessment of parental feeding practices [47, 66, 67], but methods to assess nutrition and physical activity-related environments specifically at preschool have also been developed [52, 68-70].

One tool that has been used in many studies [35, 42, 43, 71, 72] is the Environmental Policy Assessment and Observation (EPAO) tool, which was originally an observation tool that assesses both food and physical activity environment at preschools [68]. The food environment part of the EPAO consists of the assessment of foods and beverages served to children and the mealtime practices of early educators. It also includes a policy assessment tool. The use of the EPAO as a self-reporting instrument for early educators has subsequently been validated [73]. Ward et al. have also developed a self-assessment tool, the Nutrition and Physical Activity Self-Assessment for Child Care (NAPP SAC), for preschool managers and personnel to assess preschool nutrition and physical activity environment and practices [69, 74]. Other instruments used in preschool settings include Henderson et al.'s RUDD survey to assess the child-care nutrition and physical activity environment [70, 75] and the childcare food and activity questionnaire [75]. Swindle et al. [52] have also developed a self-report instrument for early educators to assess their mealtime practices and beliefs.

Use of preschool mealtime practices

Many varying practices have been assessed in studies on preschool mealtime practices, and there is no clear definition of which factors are considered mealtime practices at preschool. The practices studied most often are those named in recommendations, but other practices, such as child involvement in cooking/baking, having food/nutrition posters on display, and food education for children have also been studied [76].

Several studies on preschool mealtime practices have been published in recent years. Here I present studies that have examined practices in preschools assessed either by self-report or observed by research personnel. No experimental studies were included. The vast majority of the studies have been

conducted in the USA, while studies from other countries are rare. No studies from Finland were found. Table 2 presents the studies.

The prevalence of different mealtime practices vary greatly in the studies presented in Table 2. Role modelling by the personnel, i.e., eating the same food as children with the children or eating healthy foods in front of children, varied between 8 and 97 percent [42, 44, 67, 76-78]. Role modelling has been assessed in slightly different ways in different studies, thus making comparisons challenging. For example, the lowest prevalence was from a study that observed personnel "always role modelling healthy eating enthusiastically" [78], whereas, for example, in Nanney et al.'s study, personnel have self-reported whether there was "At least one adult sitting at the table and eat the same food as children" [44]. Some studies only examined sitting with the children [79, 80]. The prevalence of the family-style serving style varied between 7 to 97% [66] but mostly it was below 40% [42, 67, 76, 77, 80, 81]. Encouraging children to try new/less-popular foods and drinks was found to be common in many studies [25, 35, 42, 78, 80, 81], but the prevalence was mostly lower in observational studies [35, 42, 78] than in self-report studies [25, 43, 44, 67, 76-79, 81]. Rewarding with food and using food to control child's emotions were rare [25, 35, 44, 78, 80-82].

Part of the variation in the mealtime practices used can be caused by some US preschools participating in preschool programs that regulate mealtime practices. Such programs are the US Department of Agriculture's Supplemental Nutrition Assistance Program Child and Adult Care Food Program (CACFP) [32] and Head Start [83], which are both directed at low-income children. Head Start preschools and preschools participating in CACFP have to follow strict meal standards and recommended mealtime practices [32, 53]. As a result, the use of recommended practices is clearly more common in Head Start preschools compared to CACFP and non-CACFP preschools and more common in CACFP preschools than in non-CACFP preschools [31, 67, 84].

The lowest prevalence rates for recommended practices were seen in observational studies [35, 42, 78, 80]. Thus, some of the variation in study results may be due to social desirability bias in self-reported studies. Also, the different wording of the studied practices can cause variation of prevalence rates both in self-reported and observational studies.

Table 2. *Studies reporting the personnels' mealtime practices at preschools.*

First author, year, and study country	Number of study participants	Method used	Main results
Gubbels 2015, the Netherlands	24 early educators	Self-report (with a dietician)	Personnel eats the same food as the children often or always 63% Personnel uses food to control behaviour often or always 0% Encouragement to eat new foods often or always 68% Child involvement in food preparation often or always 46%
Gubbels 2018, the Netherlands	116 early educators from 23 preschool	Self-report	Modeling (scale 0–5) 4.5 points Pressure to eat (scale 0–5) 3.3 points How often do you give a child something to eat or drink if s/he is upset, even if you think s/he is not hungry (scale 0–5) 1.3 points
Sisson 2012, USA	314 preschools	Self-report	Personnel sit with children most to all of the time 81% Personnel eat the same food as children most to all the time 79% Meals are served family style most to all of time 42% Personnel encourage trying new foods all the time 63% Food is rarely/never used to encourage good behaviour 88%
Kharofa 2016, USA	60 preschools	Observation	Children self-serve 12% Personnel sit most of meal 29% Personnel eat some of the same food 66% Personnel talk about healthy food 33% Personnel encourage at least once 76% Child gets seconds even though they did not ask 37%
Sigman-Grant 2008, USA	568 preschools	Self-report by managers	Family style food service 38% Personnel usually sit at table 58%

	(1190 early educators)	and personnel	Personnel eat some of same food as child but eats own meal later 28% Children do not pour their own drinks 61%
Neelon 2015, England	851 nurseries	Self-report by nursery managers	Children are not expected to clean their plates 63% Drinking water available to children 86% Children are encouraged to choose the food they are going to eat for themselves 84% Carers sit with children during meals whenever possible 46% Children are provided with small servings first, with the opportunity to have second helpings if they finish the first 61%
Benjamin Neelon 2012, USA	96 preschools	Observation	Some meals and/or snacks were served family style 15% Personnel did not ask children if they were full before serving second helpings 57% Personnel encouraged children to try new/less familiar foods 76% Personnel used food to reward behaviour 6% Personnel sat with children during meals and snacks 71% Personnel consumed less healthy foods or drinks in front of children 34%
Fallon 2017, USA	85 early educators	Observation and self-report	Self-report vs. observation Never using food as reward 98% vs. 100% Never using food to control child's emotions 99% vs. 98% Never pressuring child to eat more than they seem to want 71% vs. 94% Always encouraging children to try new foods 85% vs. 48% Always role modelling healthy eating enthusiastically 82% vs. 8%
Dev 2013, USA	118 preschools	Self-report	Comparison of 3 types of preschools: Head Start*, CACFP** and non-CACFP Personnel always sit with children during meals 87%, 73%, and 45% respectively Personnel always eat meals together with children 97%, 67% and 42% respectively Meals are served family style 97%, 44% and 7% respectively

			Personnel help children recognize internal hunger and satiety cues 26%, 26% and 23%, respectively
Ward 2017, Canada	50 preschools	Observation	Modelling (scale 0–9), mean 4.9 Satiety recognition (scale 0–12), mean 5.1 Verbal encouragement (scale 0–9), mean 3.2 No use of food as rewards (scale 0–3), mean 2.8 Nutrition education (scale 0–6), mean 1.9
Nanney 2016, USA	428 preschools	Self-report	Food is not used as reward or punishment 71% Allow children to decide when they are full 72% At least one adult sit at the table and eat the same food as children 67%
Liu 2016, USA	229 childcare settings (preschools and family childcare homes)	Self-report	Comparison of CACFP* and non-CACFP childcare settings: Always eat the same foods the children are offered 53% and 35% Never eat foods children are not allowed to have in front of the children 48% and 47% Always serve meals family style 41% vs. 29% Cook with the children at least once a month 50% vs. 43%
Gerritsen 2016, New Zealand	257 childcare settings	Self-report	Personnel never use food to reward good bahviour 95% Personnel always sit with children while they eat 80% Children sometimes or always serve themselves from a communal plate 71% Personnel always or mostly eat and drink the same things as children 27%

*Head Start is a federally supported preschool program for low-income children

**CACFP is The United States Department of Agriculture's (USDA) Child and Adult Care Food Program

2.3.2 CHARACTERISTICS AND FOOD OPINIONS OF PERSONNEL

The characteristics of preschool personnel and managers, such as education, knowledge, attitudes and opinions, can also influence children's dietary intake mainly via mealtime practices or food availability. In a socioecological model, characteristics of personnel could be placed at the closest level to the child due to their presence at mealtimes. Some studies have assessed the characteristics and food-related opinions and attitudes of early educators. Sharma et al. [85] found that Head Start teachers were mostly obese, had poor nutrition knowledge (both examined by questions and self-assessed), and were insecure about sources of reliable information on nutrition. Dev et al. [66] reported feeding style and attitudes of early educators in Illinois. These early educators were also mostly obese. Freedman et al. [86] reported early educators' knowledge of child feeding to be fairly good, although it was not always congruent with their practices. These studies were all conducted in the US and among an ethnically diverse population. Studies from other countries were not found.

Preschool managers can also influence children's dietary intake via their possible influence on mealtime practices and food availability. Studies on preschool managers are rare, though. No studies of preschool managers' characteristics, such as opinions, attitudes or nutrition knowledge were found. Although not from a preschool setting, Olstad et al. [87] studied managers of recreational sports settings in a qualitative study and concluded that managers' decisions and actions concerning the implementation of dietary recommendations are shaped by their nutritional knowledge and attitudes.

2.3.3 FOOD EDUCATION FOR PERSONNEL, PARENTS AND CHILDREN

Food/nutrition education is another factor in the preschool mealtime environment that could have a role in children's dietary intake. The Finnish recommendations define food education as any food-related activity at preschool either during or outside mealtimes [7], but food/nutrition education is mostly assessed in studies on the preschool mealtime environment as food/nutrition-related training for the personnel, curriculum-included food education for children, and/or food/nutrition education for parents [24, 35, 44, 67, 80, 88]. Some studies view informal food talk during mealtimes as food education [35, 80]. Food education could be located at the preschool level in a socioecological model when food education is defined as training for the personnel, and education for parents and children. Previous studies have assessed and reported food education differently, and the prevalence of different types of food education varied, but some studies reported that the majority of preschools offer nutrition training for the personnel at least once a year [80, 81]. In general, the studies also reported nutrition training for

personnel as more common than food/nutrition education for children or parents, but curriculum-included food education for children was also prevalent [67, 80, 81].

2.3.4 FOOD POLICIES

Food policies are a preschool's written policies on food-related matters, such as foods served to children, mealtime practices used by early educators, and other rules concerning food and mealtimes. Food policies, if they concern the whole preschool, are also situated at the preschool-level in a socioecological model. Food policies seem to be associated with using more recommended mealtime practices and serving recommended foods [88-90].

Nanney et al. [44] reported that 41% of center-based childcare settings have a written healthy nutrition policy and implement it. Benjamin Neelon et al. [80] reported that 80% of preschools had a written policy on nutrition, and 52% had written guidelines on foods served for holidays and celebrations. Falbe et al. [91] have developed an instrument to quantitatively evaluate written food and physical activity policies according to their comprehensiveness and strenght. They found, unsurprisingly, that Head Start preschools scored much higher in both comprehensiveness and strength of food policies. Gerritsen et al. [24] have assessed preschool food policies in New Zealand with the same instrument and stated that even though approximately 80% of preschools had a food policy, they scored low in comprehensiveness and strenght. Lucas et al. have examined national school and preschool food policies on foods served in Australia, the UK and Sweden [23]. They conclude that although the three countries have very different (pre)school meal systems, they would all benefit from consistent policies, incentives for compliance and systematic implementation monitoring. To my knowledge, there are no studies on preschool food policies in Finland.

2.4 SOCIOECONOMIC STATUS AND PRESCHOOL MEALTIME PRACTICES

Some interest exists in examining the determinants of the differences that have been found in the varying use of recommended preschool mealtime practices. Such determinants could be placed in a socioecological model either at the preschool level or at a more distal level, e.g., the community or neighbourhood levels. Differences attributed to the child care program (e.g., Head Start, CACFP, non-CACFP) and their requirements are quite well documented [31, 76, 84, 92], but other determinants can exist as well. Bussell et al. [88] found that the ethnicity of the children in the preschool was associated with the foods served in US preschools. Preschools that had sponsor organisations also used more recommended mealtime practices. An English and a New Zealand study have examined preschool mealtime practices

according to the area's deprivation [24, 79]. Neelon et al. [79] found that in England, preschools in more deprived areas used more recommended mealtime practices, whereas no such differences were found in New Zealand [24]. Copeland et al. [93] has found that a higher percentage of children receiving tuition assistance (i.e., low-income children) in a preschool was associated with a more restrictive physical activity environment. Thus, these few studies imply that the area's socioeconomic status or the children attending a preschool may be associated with mealtime practices or other health behavior-related practices at preschool. The hypothesis behind studying such association might be that in high SES neighbourhood preschools practices could be closer to recommendations. Such differences in practices could be due to the children's characteristics, for example less problematic behaviour in high SES neighbourhoods [94, 95], or higher educational level of the personnel in high SES neighbourhoods.

2.5 PRESCHOOL MEALTIME ENVIRONMENT AND CHILDREN'S DIETARY INTAKE AT PRESCHOOL

A small number of studies have examined associations between mealtime practices or other mealtime environmental factors and children's dietary intake at preschool [25, 31, 35, 42, 43]. All of these studies are cross-sectional and originate from the US [31, 42], Canada [35], and the Netherlands [25, 43]. Additionally, there is at least one study on food policies and children's dietary intake [96]. Table 3 presents these studies and their main findings.

Role modelling by the personnel has been found to be associated with higher energy and vegetable intake [42] and higher fibre intake [43]. Personnel eating together with children (but not necessarily the same food as children) was also associated with higher energy and fibre intake [43]. Additionally, two studies have found that role modelling by the personnel was associated with higher consumption of sweet snacks or sugar [25, 35], whereas two other studies did not examine children's sugar intake [42, 43]. No associations between role modelling and children's dietary intake were observed in Andreyeva et al.'s study [31].

Associations between informal food talk and children's dietary intake were examined in three studies [25, 35, 43]. Gubbels et al. [43] found that informal talk about healthy foods was associated with higher fibre intake, and in her other study, personnel explaining food preparation for children when preparing meals was associated with higher fruit consumption [25]. Ward et al. [35] found that nutrition education for children (informal talk and formal education combined) was instead associated with lower energy and fibre intake.

Regarding food policies and children's dietary intake, a Norwegian study found that having policies on foods served to children was associated with higher consumption of vegetables among children [96]. Bussell et al. [88]

additionally found that a higher number of food policies was associated with more recommended practices regarding the foods served. Comparisons on preschool programs that are strictly regulated or not-regulated (CACFP preschools vs. non-CACFP preschools) have found that CACFP preschools serve more recommended foods than non-CACFP centers [31, 76, 84, 92], but CACFP participation was not associated with the number of written food policies. Thus, differences in foods served may be attributed to the food reimbursement system or higher compliance with the policies compared to non-CACFP preschools [76].

Associations between food/nutrition education (training for personnel or education for children or for parents) and children's dietary intake have not been reported, to my knowledge. In addition, to my knowledge, there are no studies on early educators' characteristics, such as educational level, nutrition knowledge, attitudes and opinions and their possible associations with children's dietary intake.

Instead of relations between the personnels' characteristics and the children's dietary intake, some studies have examined the personnels' characteristics and their associations with mealtime practices [66, 72, 86]. Dev et al. [66] conclude that individual-level factors, such as education, race, training and attitudes, together with preschool-level factors, are associated with personnels' mealtime practices. For example, non-white personnel and personnel who are trying to lose weight used more restrictive feeding practices. Freedman et al. [86] also pointed out that race was an important factor for mealtime practices in the US context, as Hispanic early educators used more not-recommenced practices. Food education (any food-related activities at preschool) in Finland has been studied in a Master's thesis [97]. That thesis found that early educators with a higher educational level and higher professional titles (teachers or managers vs. daycare workers) use child-based and interaction-based food education styles more than early educators with a low educational level.

Table 3. *Studies reporting associations between the preschool mealtime environment and children's dietary intake at preschool.*

First author, year, and study country	Number of study participants	Age of the children	Assessment methods	Main results
Khafora 2016, USA	349	3-5	Lunch time observation of children's food consumption and personnels' mealtime practices by research personnel	Personnel sitting with children was associated with higher vegetable intake and lower energy intake. Personnel eating some of the same food was associated with higher energy intake and vegetable consumption. Encouragement to try new/less favourite foods was associated to lower fruit intake. Family-style meal service, personnel talking about healthy foods, and personnel helping children assess hunger before seconds: no associations.
Gubbels 2010, the Netherlands	135	2-3 years	Observation of children's food consumption and personnels' mealtime practices by research personnel	Family serving style was associated with higher SAFA and fibre intake. Personnel eating together with children was associated with higher energy and fibre intake. Personnel eating the same food as the children was associated with higher fibre intake. Personnel encouraging children to overeat was associated with lower intake of energy, SAFA and fibre.
Gubbels 2015, The Netherlands	398	1-4 years	Precoded food record kept by preschool personnel, self-report of mealtime practices	Personnel explaining food preparation for children was associated to higher fruit consumption. Children helping with meal preparations was associated with eating less sweet snacks. Personnel encouraging to continue eating was associated with eating more vegetables.

				Role modelling by the personnel was associated with eating more sweet snacks.
Ward 2017, Canada	723	-	2-d Weighed plate waste and digital photography, Observation of mealtime practices by research personnel	Modelling of healthy eating was associated with higher intake of sugar. Providing nutrition education was associated with lower energy and fibre intake Not using food as a reward was associated with lower fat intake. Nutrition education was associated with lower intake of energy and fibre.
Andreyeva 2018, USA	838	-	Observation and plate waste assessment of food consumption on one lunch by research personnel. Observation of mealtime practices by research personnel	Family style service was associated with lower intake of SAFA. Role modelling by the personnel, asking whether children want more food, and deinying seconds: no associations.
Himberg-Sundet 2019, Norway	73 preschools	-	5-day vegetable diary, including weighing vegetables served and left overs filled by preschool personnel	Having written guidelines for meals served at preschool was associated with higher vegetable consumption among children.

2.6 SUMMARY OF THE LITERATURE REVIEW

Relatively many studies have in recent years explored children's dietary intake or foods served at preschools, especially in the USA. The conclusions of these studies are mainly that the dietary intake of children or the foods served to children at preschool are mostly challenged by less than the recommended consumption/serving of vegetables, and partly fruits and whole grains/fibre as well (see Table 1) [25-31, 34, 36]. High consumption/serving of sweet foods and drinks and salty and high fat foods were also prevalent in many studies [25-29, 37, 39]. Consumption of other food groups was more varied. The results from Finland and Sweden differ from the US studies, as the dietary intake among Swedish and Finnish preschoolers has been found to be relatively healthy [40, 41]. Though there are shortcomings in the foods served and eaten at preschool, both the US and Nordic studies have shown that the dietary intake at preschool was usually closer to recommendations than the dietary intake at home [33, 40, 41]. The Netherlands comparison yielded different results, which might partly be due to (preschool) lunches in the Netherlands mainly consisting of sandwiches, while the only warm meal on weekdays is eaten at home at dinner time [38].

There was some variation in the dietary assessment methods used in the studies. Different methods yield different systematic errors [98], and some methods can lead to systematic overestimation of amounts eaten, which might have been the case in Er et al.'s study [37] that found high consumption of vegetables and fruits among English preschoolers. It is also important to take into account that some studies examined foods served to children and others foods eaten by children. It is not self-evident that all foods served are also eaten [99, 100].

There is a growing number of studies on the use of different mealtime practices [24, 25, 42, 44, 67, 76-82]. The large majority of these studies originate also from the USA. The use of mealtime practices has been quite varied in these studies, but on average, family-style serving style was in use in a minority of preschools, and around half of the early educators eat the same food as the children (see Table 2). Encouragement to try new/less favourite foods is very common, whereas using food as a reward/punishment is rare. These findings are mainly examined in self-report studies, which may cause overestimation of recommended practices and underestimation of discouraged practices [78]. Studies from other countries are also needed.

Some studies have investigated preschool food policies [24, 44, 80, 88, 90]. According to these studies, the existence of policies is common, but the strength and comprehensiveness of the policies vary.

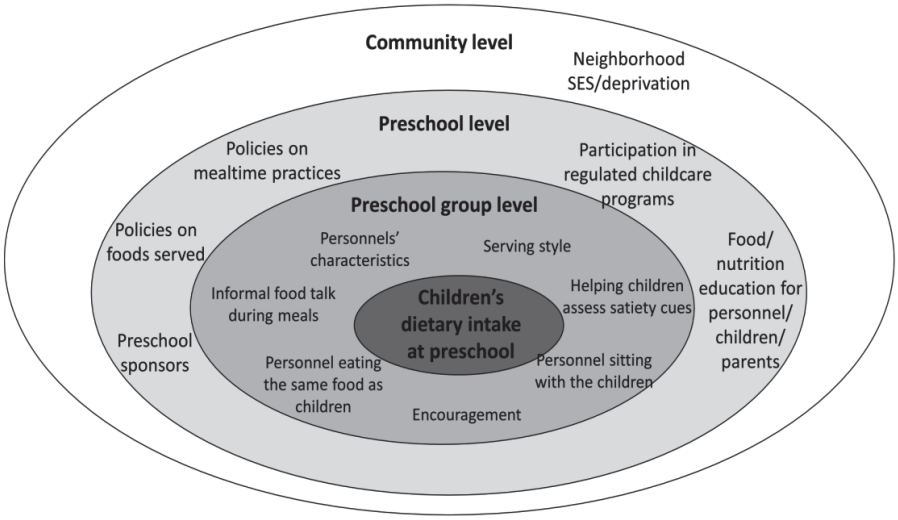


Figure 2. A summary of topics studied about the preschool mealtime environment and children's dietary intake at preschool in a socioecological model.

Despite the relatively large number of studies examining children's dietary intake or foods served at preschool, preschool mealtime practices, and other mealtime environmental factors at preschool, only a few studies have examined the associations of the mealtime environment to children's dietary intake (see Table 3) [25, 31, 35, 42, 43]. Figure 2 presents associations examined in previous studies in a socioecological model, though not all of the presented factors have been studied as determinants of children's dietary intake. The studied variables and outcomes have varied in the presented studies, but the most studied have been role modelling by the personnel, serving style and encouragement to try new/less popular foods (see Table 3). Role modelling by the personnel has been quite consistently associated with children's dietary intake, either to higher intake of vegetables [42], energy, fibre [43] or sugar/sweet foods [25, 35]. Otherwise, the findings have been mixed, and many null associations have also resulted. Studies examining other factors than mealtime practices are rare, but Himberg-Sundet have found, for example, that policies are associated with higher vegetable consumption among children [96]. Associations between neighbourhood socioeconomic status/deprivation and mealtime practices have been studied in a few studies with mixed results [24, 79].

While a few studies on the preschool meal environment's associations with children's dietary intake have been conducted, much still remains unknown. Possible factors to be studied are at many different levels of a socioecological model, e.g., preschool-level barriers and facilitators of healthy eating and preschool managers' and early educators' characteristics have not been studied. Knowledge of the determinants of using recommended feeding

practices is also needed. Additionally, results from one country may not be applicable elsewhere, because the wider context of the childcare system and foods served to children differ greatly between countries [21, 23, 76].

3 AIMS

The aims of this thesis are to examine how the preschool meal environment is associated with children's dietary intake at preschool in Finland and whether the preschool neighbourhood socioeconomic status is associated with preschool mealtime practices.

The specific aims of the sub-studies are to examine:

I how early educators' mealtime practices and opinions about the preschool food are associated with children's dietary intake at preschool.

II whether preschool-level factors, such as food policies, preschool-level barriers and facilitators, and manager's opinions are associated with children's dietary intake at preschool.

III the associations between preschool neighbourhood socioeconomic status and mealtime practices at preschool.

4 METHODS

This thesis is part of the Increased Health and Wellbeing in Preschools (DAGIS) study. The aim of DAGIS study is to examine Finnish preschoolers' energy balance-related behaviours (EBRBs) and stress, to decrease socioeconomic differences in these behaviours and promote healthy EBRBs among all children [101, 102]. The DAGIS study includes focus groups, a cross-sectional survey among preschoolers and their families, and a preschool intervention. This thesis consists of the data from the cross-sectional survey, which was conducted in 2015 and 2016. The aim of the survey was to examine preschoolers' EBRBs and stress, their determinants at home and at preschool, and to detect possible socioeconomic differences in the EBRBs. The survey received a favourable assessment by the University of Helsinki Ethical Review Board in the Humanities and Social and Behavioural Sciences in February 2015 (#6/2015).

4.1 SAMPLE AND PARTICIPANTS

We aimed to recruite a socioeconomically diverse sample of Finnish preschoolers for the survey; therefore, we contacted municipalities with socioeconomically diverse populations. Socioeconomic diversity was checked from national statistics [103]. Our selection was based on the Gini coefficient and the proportion of single parents and people with a low educational level in the municipality. Another criterion was that the municipalities had to be located at a convenient distance from the research centers, because the study procedure included several visits to the preschools.

We contacted 11 municipalities in the Uusimaa and Southern Ostro-Bottnia regions. Eight (73%) municipalities (Vantaa, Hyvinkää, Lohja, Porvoo, Loviisa, Seinäjoki, Kauhajoki and Kurikka) gave us permission to contact their preschools. We contacted municipal and outsourced preschools in these municipalities based on lists of preschools we received from the municipal authorities. The criteria for participation were that the preschool had to: 1) have at least one group of approximately 3- to 6-year-old children, 2) provide early education only during the daytime, 3) be Finnish or Swedish speaking, and 4) charge income-dependent fees (all municipal preschools charge income- and household-size dependent fees). We continued the recruitment of preschools until we estimated that we would reach the desired number of participants (circa 800 children). This target was set based on power calculations that were done in order to detect socioeconomic differences in children's screen time and intake of sugar.

We contacted 169 preschools in the participating municipalities, of which 16 were excluded based on the aforementioned inclusion criteria. Of the remaining 153 preschools, 86 agreed to participate (56%). The managers of the preschool signed an informed consent. Then, via the preschools, we recruited the families who had their child in a preschool group for 3-6-year-old children in the participating preschools. Groups of preprimary education (solely 6-year-olds) were excluded. A parent or a legal guardian signed an informed concent for the child to participate in the study. In 20 prescools the participation rate remained too low among the families (<30% in all groups), and we did not conduct the study in those preschools, because of the research resources they would have demanded. In total, the parents of 3592 children were contacted, of whom 983 agreed to participate (27%). Of these children, 91 were in the preschools that had too low a participation rate and were thus excluded; 892 children remained in the sample. We did not receive any data during the data collection from 28 children; thus, the ultimate sample consisted of 864 children (24% of the total sample). Figure 3 presents the flow chart of the participants. Preschool managers and personnel, in addition to the children and parents, participated in the survey by filling in questionnaires and taking part in the data collections. Early educators did not sign a consent, but it was pointed out to them that filling in the questionnaires was voluntary. The total number of early educators working in the participating preschool groups was 522. The number of preschool managers was 56. Eight managers had 2, and one had 3 participating preschools in the study.

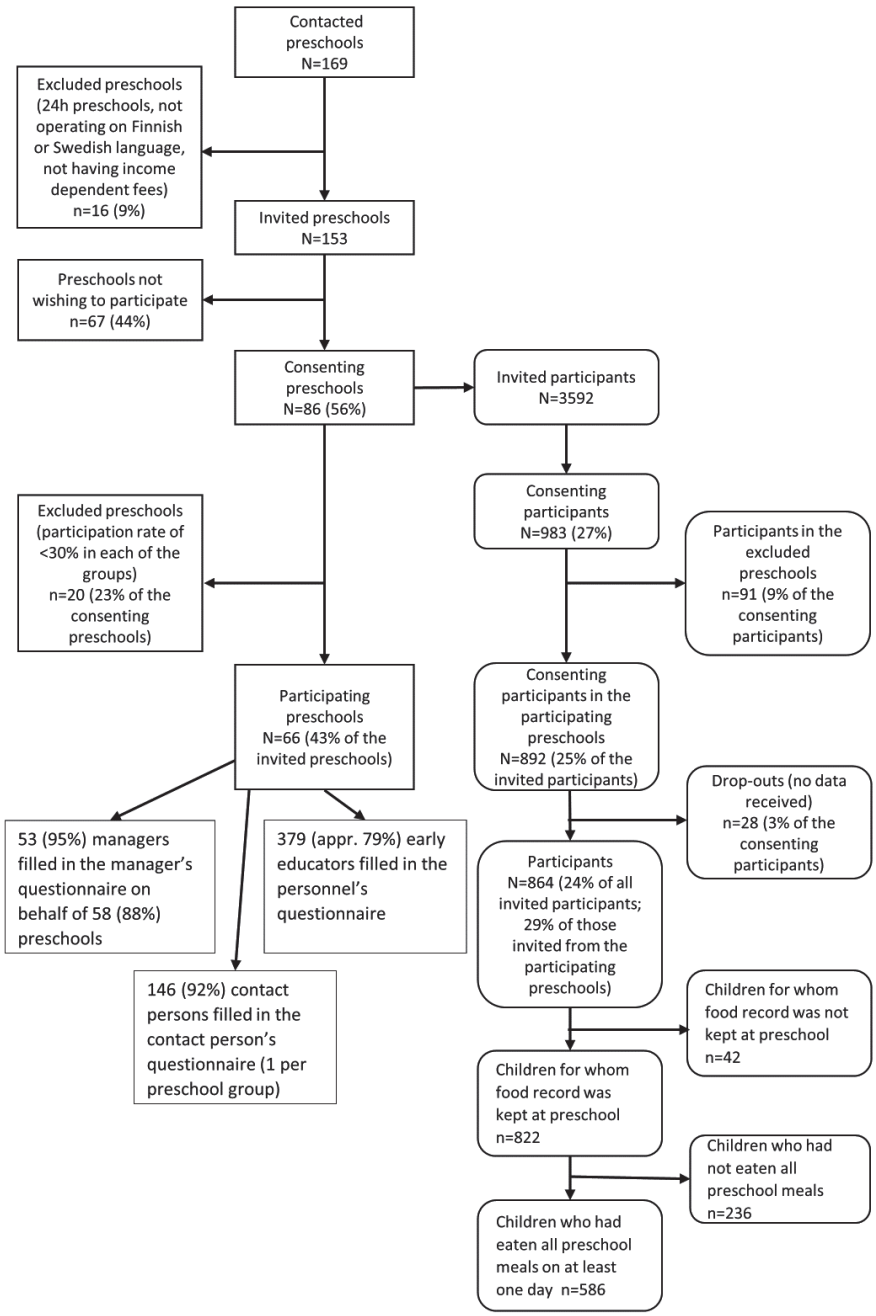


Figure 3. *Flow chart of DAGIS survey participants.*

4.2 DATA

We used several methods to gather data on children's dietary intake, preschool mealtime environment, and preschool neighbourhood SES. Food records were kept to assess children's dietary intake at preschool. Questionnaires for preschool personnel and managers were used to study preschools' mealtime environment and practices, and, in addition, research personnel conducted an observation at lunchtime. Preschool neighbourhood SES was defined as the socioeconomic status of the population living near the preschool. Statistics Finland provided this map grid data. Next I will describe in more detail all the data used in the thesis.

4.2.1 ASSESMENT OF CHILDREN'S DIETARY INTAKE

Children's dietary intake during preschool hours was assessed by food records. Early educators were asked to keep food records for the participating children on two predefined preschool days. Those days were divided within one week in each preschool group to lighten the personnels' workload, so that records were not kept for all children at the same time. The days were synchronized with the food record kept by parents outside preschool hours. Research personnel instructed the early educators about keeping the food record in person, and the food record also included written instructions. The food record was precoded to aid its completion, and breakfast, lunch and afternoon snack each had predefined sections. There was also a place for other eating occasions. Food groups for each meal had predefined rows, such as porridge and bread for breakfast, and salad, main course and side dish at lunch. Early educators were asked to fill in all foods and drinks the child had consumed and their amounts, either in household measures or by using the validated Children's Food Picture Book [104, 105]. That book was developed for the DAGIS project to aid in estimating the children's portion sizes. It contains pictures of foods commonly eaten by Finnish children in different portion sizes. Recipes for the foods and information on the foodstuffs used were requested from the municipal preschool catering service. We received the recipes in full from five out of eight municipalities, partly from one municipality, and not at all from two municipalities. We used recipes from other catering services, or as a last resort, the composite dishes in the national food composition database when a recipe was missing.

The children's parents kept a food record outside the preschool hours on two weekdays and on one weekend day simultaneously with the preschools' food record keeping. Parents received the food record via mail; it also included written instructions and an example day. Parents were asked to report all foods and beverages, including all ingredients of composite dishes and product names for packaged foods their child had consumed. Portion sizes were requested to be estimated by weighing, using household measures or from package labels. Parents also received the Children's Food Picture Book [104].

Research assistants checked the returned food records for important missing information and contacted the parents if needed. The checking mainly focused on fruits, vegetables and sugar-containing foods and beverages, which were the main focus of the dietary assessment data in DAGIS research.

We used the nutritional software Aivodiet version 2.2.0.0 (Aivo Finland Oy, Turku, Finland) to enter the food record data and to calculate the children's food consumption and nutrient intakes. Aivodiet uses the Finnish national food composition database Fineli, which is maintained by the Finnish National Institute for Health and Welfare [106].

The inclusion criteria for the analyses were that the child had eaten all three meals (breakfast, lunch and snack) at preschool on at least one day. If other eating occasions (such as excursion snacks) occurred, they were also included. The mean intakes at meals that had been eaten on both of the record keeping days were calculated to compute a mean daily intake of a certain dietary variable. Then all meals were summed up.

Dietary intake variables used

The dietary intake variables used in this study were the consumption of vegetables, fruits and berries; dietary fibre, sucrose, and added sugar intake; and the proportion of daily energy intake from preschool food. Vegetables, fruits, berries and fibre were chosen to describe healthy dietary intake. Added sugar was included, because it was one of the main nutrients of focus in the DAGIS study. These are also all dietary factors for which children often fail to meet the recommendations [107-109]. The proportion of daily energy intake during preschool hours was examined to be able to compare the intake with the recommendation [7].

The consumption of vegetables was assessed as grams per day and included raw and cooked vegetables eaten as such (not in composite dishes). Potatoes were not included. Consumption of fruits and berries was a dichotomous variable (eaters vs. non-eaters). Fresh fruits and fresh and frozen berries were included. The reason for the use of the dichotomous variable was that the proportion of children who had not eaten any fruits or berries at preschool during the two days was high (35%). Fibre density was assessed as g/MJ; the proportion of energy intake from preschool food was assessed as a percentage of the day's total energy intake. Total energy intake was summed from the preschool and home food records. Dietary intake variables were used as continuous variables except for fruits and berries consumption. Vegetable consumption was not normally distributed; therefore, a square-root transformation was used.

The estimation of added sugar intake was a complex process. Although the recommendation for sugar intake is given as added sugar, added sugar is not included in composition databases [106]. Instead of added suger, studies usually assess sucrose intake [110] or an estimation of added sugar intake with

a single coefficient from the total sucrose intake [108]. We developed a more subtle way to assess the added sugar content of foods and drinks in the DAGIS study to gain a more accurate estimate of its intake. This was done by estimating the proportion of added sugar in foods and beverages separately in all food groups that contain significant amounts of sugars. We classified these 41 food groups as containing either only naturally occuring sugars, only added sugars, or both. A formula representing the average proportion of added sugar from total sugar in that food group was used for food groups that contain both naturally occuring and added sugar. The sucrose and total sugar content of each food was available in the composition database [106]. We used information from package labels, the national food composition database, and commonly used recipes about the proportion of ingredients including natural sugars (e.g. fruits, berries) in a certain food to estimate the relative amounts of naturally occurring and added sugar in that food. For example, in the case of sugar-sweetened jams and marmalade, the total sugar content of each food in that group was multiplied by the estimated proportion of added sugar. The total sugar was treated as added sugar if foods in a food group contained only negligible amounts of natural sucrose, and the sweetener was sucrose. Conversely, if foods in a food group contained only negligible amounts of added sugar, the total sugar was treated as naturally occuring sugar.

4.2.2 PRESCHOOL MEALTIME ENVIRONMENT

Data on preschool mealtime environment and mealtime practices were gathered via questionnaires and observations, which are found on the DAGIS website [111]. Several questions were taken from previously validated questionnaires [69, 70, 112], translated in Finnish and back-translated. Self-developed questions were also used to better account for the Finnish context. The self-developed questions were not validated. Focus groups conducted among preschool personnel earlier in the DAGIS project aided in developing the questionnaires [113].

Three different questionnaires were used among preschool personnel and managers. These were the early educators' questionnaire that was intended for all early educators, the contact person's questionnaire that was additionally intended for one early educator in each preschool group, and the preschool manager's questionnaire. All questionnaires were available in Finnish and Swedish. English translation was performed by the DAGIS research group.

Early educators' questionnaire

Early educators were asked to fill in the early educators' questionnaire, which included questions on demographics, opinions about preschool food, and the mealtime practices used.

Table 4. The v*ariables used to assess mealtime practices and food-related knowledge and opinions of the early educators.*

Variable name	Questions/statements	Scale
Role modelling (sub-study III)	How many times per week do you eat the same food as the children at lunch[1]?	Open
Role modelling (sub-study I)	Where do you usually eat your lunch on weekdays[1]?	1. together with children, at the same table; 2. in the same room with children but at a different table; 3. in preschool away from the children; 4. somewhere else; 5. I don't eat lunch.
	How many times per week do you eat the same food as the children at lunch?	Open[2]
Positive opinion of the food (sub-study I)	1) The food served in preschool is healthy[1]; 2) the food served in preschool is versatile[1]; 3) the food served in preschool is tasty[1]; 4) the food served in preschool is appetizing[1]; 5) the food served in preschool is suitable for children[1].	1 (totally disagree) – 5 (totally agree)
Encouragement to eat FV (sub-study I)	1) How often do you praise the children when they try new or unpopular fruits, berries or vegetables[3]?; 2)How often do you urge the children repeatedly to taste new or unpopular fruits, berries or vegetables[1]?; 3) How often do you encourage the children to eat fruits, berries or vegetables[1]?	1 (never) – 5 (always)
Using food as a reward (sub-studies I and III)	How often do you reward the children with other food for eating vegetables[3]?	1 (never) -5 (always)
Opinion on the adequacy of vegetables (sub-study I)	There are enough vegetables served in the preschool[1].	1 (totally disagree) – 5 (totally agree)
Knowledge of the FV recommendation (sub-study III)	What do you think is the official fruit and vegetable intake recommendation for children, how many portions per day[4]?	Open
Opinion on the amount of sugar in the preschool food	What is your opinion about the amount of sugar in the foods offered at the preschool?[1] (sub-study I)	1. Too little 2. Right amount 3. Too much

FV Fruits and vegetables

[1] self-developed, not validated

[2] calculated for those early educators who eat at the same table together with the children.
[3] from the NAP SACC questionnaire, validated [69]
[4] modified from Toybox teacher's questionnaire [112]

Many of the mealtime practice questions were translated (and modified) from the NAP SACC self-assessment questionnaire [69] and the Toybox teacher's questionnaire [112]. In total, 379 questionnaires were completed, with a response rate of 79% (364 out of 461) in groups where at least three children participated. Not all early educators were asked to fill in the questionnaire in groups where two or fewer children participated (18 out of 159 groups).

In total, seven mealtime practices or opinions from the early educators' questionnaire were used in sub-studies I and III. Table 4 presents these practices and opinions, their scales and the questions/statements they were formed from. These were role modelling, encouragement to eat FV, using food as a reward, positive opinion of the food, opinion on the adequacy of vegetables, opinion on the amount of sugar in the preschool food, and knowledge of the FV recommendation for children. Encouragement to eat FV also include berries. Role modelling was used differently in sub-studies I and III: in sub-study III, eating the same food as the children was considered as role modelling, whereas in sub-study I, only the early educators who ate at the same table and the same food as the children were considered to be role models. In that study, role modelling was a continuous variable in that early educators who reported not eating at the same table with children were given value 0, and others were given the frequency of eating the same lunch as the children per week.

Contact person's questionnaire

In addition to the early educators' questionnaire, one early educator from each preschool group was asked to fill in a questionnaire on group-level mealtime practices. This questionnaire is called the contact person's questionnaire, because each group had a study contact person who was asked to fill in this questionnaire. The questionnaire included questions such as whether the children participate in meal preparations or if extra foods are served on the children's birthdays. A separate questionnaire was used, because these group-level practices did not need to be asked from all early educators. In total, 146 out of 159 (92%) contact persons completed that questionnaire.

Two questions were used from the contact person's questionnaire. The first question was whether there was food outside the menu available on birthdays with these response options: a) not available; b) available, but sugary foods restricted; and c) available, sugary foods not restricted. The second question was whether the children participated in practical meal preparations such as setting the table. The five response options were "never"; "1-5 times a year"; "at least 6 times a year"; "at least once a month; and "at least once a week".

Managers' questionnaire

Preschool managers answered a separate questionnaire on preschool-level practices and rules and their personal views on children's nutrition related factors at preschool. Some of the questions were modified from validated questionnaires [70, 114], and some were self-developed and not validated. The questionnaire was completed by 53 (out of 56) managers from 58 out of 66 preschools (88%). Five managers were managers for two preschools participating in the study; therefore, they responded on behalf of both preschools separately. In total, seven variables were formed from the questions on the managers' questionnaire. Table 5 presents the formed variables, the questions they include, and their response options. The variables were food policies, food education, perceived cooperation challenges with the catering service, lack of resources, concern about children's FV consumption, perceived power over FV supplies, and kitchen type (whether the food is cooked onsite or not). Tertiles were formed based on the distribution of the answers for two variables: food policies and concern about children's FV consumption (see Table 5). Other variables were also recategorized into dichotomous variables or 3-class variables according to the distribution of the answers or the content of the answer options.

Table 5. *The variables used to assess food-related factors at preschool-level.*

Variable name	Questions/statements	Answering options	Categorization
Food policies (sub-study II)	Has the preschool own or municipal/national policies on following topics[1]: a. The personnel encourages children to eat fruit and vegetables b. Rewarding or punishing with food c. Planned food education for the children d. Personnels' training on children's nutrition e. Family guidance on children's nutrition f. Foods served on festive days g. Foods served on birthdays h. Snacks children bring from home i. Products sold for fund raising j. Special diets k. Ethical and religious diets l. Aimed portion sizes for vegetables m. Tasting rule n. Thirst drink o. Taking children's individual preferences into account p. Personnel having meals together with the children q. Personnel eating food brought from home in the presence of children r. The location of personnels' coffee break	a. No policies b. Oral policy c. Own written policy d. Municipal or national policy	1 point for each written policy (c or d)
Food education (sub-study II)	Has the preschool had in-service training for the personnel on child nutrition during the last 2 years?[2]	a. No b. Once c. Twice or more	a= 0 points, b or c = 1 point

	Has the preschool had theme weeks about nutrition/food education during the last 2 years?[2]	a. No b. Once c. Twice or more	a= 0 points, b or c = 1 point
	Is Sapere method familiar to you[2]?	a. The method has been used in the preschool b. The method is currently being used in the preschool c. The method is familiar, but it has not been used in the preschool d. The method is not familiar	a or b = 1 point, c or d = 0 points
Perceived cooperation challenges with the catering service (sub-study II)	Is the following a barrier to healthy nutrition: Lack of cooperation with the food service[1]?	Yes/no	Yes = 1 point No = 0 points
	Is the following a barrier to the promotion of healthy nutrition/ food education in your preschool: Limitations of the food service or food supplier[1]?	Yes/no	Yes = 1 point No = 0 points
	How would you describe the communication between the early educators and the food service personnel[2]?	Fluent There are insuffiencies in the communication.	a = 0 points b = 1 point
Lack of resources (sub-study II)	Is the following a barrier to healthy nutrition: A. Lack of planning time. B. Lack of materials. C. Lack of personnel[1]?	Yes/no	1 point for each barrier

Concern about children's fruit and vegetable consumption (sub-study II)	To what extent do you think that following matters are generally a problem among 3-6-year-old children? A. Low intake of vegetables and B. Low intake of fruits and berries[3]	1 not at all a problem 2 hardly a problem 3 problem to some extent 4 somewhat a big problem 5 a very big problem	Sum of a and b (scale 2-10)
Perceived power over FV supply (sub-study II)	Can the manager impact the supply of FV for children on different meals[2]?	Yes/no (separate questions for each meal)	Yes vs. no (to all questions)
Kitchen type (sub-study II)	What type of kitchen there is in your preschool[2]?	a. Cooking kitchen b. Distribution kitchen c. Heating kitchen d. Else, what? e. There is no kitchen	a and b combined vs. all others

FV fruits and vegetables

[1] Modified from Henderson et al. [70]

[2] Self-developed question.

[3] Modified from Lampard et al. [114]

Observational data on lunch situations

Trained research assistants/researchers conducted an observation in the preschools to assess the preschool environment. The observation was based on the Environmental and Policy Assessment Observation (EPAO) tool [68], and it included a lunchtime observation in each preschool group. EPAO is a validated observation tool designed to assess food and physical activity environments at preschools. The lunch situations of 133 out of 159 preschool groups were observed. Every group's lunch situation was not observed because of a limited number of research personnel. The 26 groups (16% of all groups) that were not observed were those that had the least number of children participating in the study in that preschool.

Three factors observed during lunchtime were used in this study: 1) vegetable/salad serving style, and 2) main course serving style, which both had three response options: a) ready-made portions; b) personnel choose and serve; c) children choose and personnel serve; and d) children serve themselves. The response categories were recategorised as children serve themselves vs. all others. Thirdly, the researchers observed whether the early educators sat at the same lunch tables with the children.

4.2.3 PRESCHOOL NEIGHBOURHOOD SOCIOECONOMIC STATUS

Preschool neighbourhood SES was assessed according to the SES of the population living within a 1 km radius from the preschool. The population SES data were map grid data received from Statistics Finland [115], which is based on the street adresses of the 66 participating preschools. Neighbourhood SES score was calculated from three variables: 1) educational level (the proportion of persons over 18 years of age whose highest level of education was at least Master's degree); 2) income (median income in the area logarithmically

transformed); and 3) area unemployment rate. Unemployment rate was reverse coded to acquire higher values for a lower unemployment rate. Standardised z-scores were derived for the three just mentioned variables, and the neighbourhood SES score was calculated as the mean value of the three z-scores. The score was divided into tertiles that represented low, middle, and high neighbourhood SES.

4.2.4 CONFOUNDERS

The children's age and gender were used as confounders in the analyses. We also controlled for the early educators' professional education. The question on the early educators' professional education had seven answer alternatives: 1) "none"; 2) "vocational qualification in social and health care [practical nurse]" ; 3) "bachelor of Social Services" ; 4) "college-educated social pedagogue/educator" ; 5) "college-educated early education teacher" ; 6) "bachelor's degree in education [early education teacher]"; and 7) "master's degree in education with specialization in early childhood education"). These were categorised into four classes: 1) no qualification (1); 2) vocational qualification (2); 3) bachelor of social services/social pedagogue (3 and 4); and 4) early education teacher or similar (5, 6 and 7).

Municipality or two municipal policies were also adjusted for, because the municipality has a substantial role in determining preschool food and possibly also mealtime practices in Finland. The two municipal policies used as confounders were the policy on early educators' lunch prices and the policy on birthday treats. Information about these policies was retrieved from the appropriate municipal administrators by e-mail from each of the eight municipalities. It is recommended that early educators should role model healthy eating, i.e. eat the same food as the children at lunch, thus early educators can buy the preschool lunch by paying only its taxable value, which in practice means a very low price.

However, the number of early educators who are entitled to the cheaper lunch in each group varies, depending on the municipality. Other early educators can also buy the preschool lunch, but the price is clearly higher. Based on the municipal administrators' answers, municipal policies on early educators' lunch prices were categorised according to whether or not all early educators in each preschool group receives the lunch at its taxable value. Municipalities also have policies concerning birthday treats at preschools. Bringing birthday treats to preschool to serve them to other children has been a common practice in Finland. Some municipalities have forbidden it; thus, the policy on children's birthday treats was whether or not children were allowed to bring and serve birthday treats to the other children in the preschool.

4.3 STATISTICAL METHODS

All statistical analyses were conducted with the statistical programs IBM Statistics SPSS 21.0-25.0 (SPSS Inc., Chicago, IL, USA) and M*plus* Version 7.4 [116]. Descriptives of the variables were checked as means and percentages. Linear and logistic regression models were used to test associations between the independent and dependent variables in all sub-studies. The strengths of the associations were expressed by odds ratios (OR) and 95% confidence intervals (CI) in the logistic regression analyses, while they were expressed as beta coefficients and 95% confidence intervals in linear regression. All eligible data were used in each analysis. The n of the data varied because of missing values for some variables. The nested design of the sample was accounted for in sub-studies I and III by adjusting confidence intervals for clustering at the preschool level [116]. Sub-study II used multi-level models with the preschool as the random effect.

Several early educators completed the early educators' questionnaire in most preschool groups, so answers from all the early educators in the same group were aggregated to the group level (mean of the answers were used) in the analyses

that included early educators' variables either as confounders or as independent variables in sub-studies I and III. For example, when the association between the early educators' mealtime practices and the children's dietary intake was examined, a preschool group-level mean of the examined mealtime practice was used as the independent variable.

The confounders used differed slightly in each sub-study. Confounders were chosen based on previous literature and knowledge about the Finnish early education system. Two models were fitted in sub-study I, which examined associations between early educators' mealtime practices and opinions and children's dietary intake at preschool with linear regression models. Firstly, a crude model with no adjustments was used; secondly, a model adjusted with a child's age, gender and municipality was used, with additionally adjusting with energy intake in analyses of vegetable consumption and vegetable consumption in analyses on energy intake. Two models were used in sub-study II, which examined the associations between preschool-level factors and children's dietary intake at preschool with multi-level linear and logistic analyses. The first model included no adjustments, and the second one was adjusted with the child's age, gender and municipality. Participants of one municipality (n=3) were not included in the analyses in this sub-study, since they were all from the same preschool and had no variation in the independent variables. Sub-study III examined the associations between preschool neighbourhood SES and mealtime practices in the preschool groups with two logistic regression models: the first with no adjustments, the second adjusted with the early educators' educational level and the municipal policies on early educators' lunch prices and on children's birthday treats.

5 RESULTS

5.1 DESCRIPTIVE RESULTS

Table 6 shows the demographics of the participating children, early educators, managers, preschool groups and preschools. The number of children who met the inclusion criteria of having eaten all preschool meals on at least one day was 586, whereas in total, food record data from their preschool were received from 822 children (Figure 3). The children who were included in the analyses did not differ from the total number of children from whom there is preschool food record data according to age, gender or highest educational level in the family. Less than half of the participating children were girls, whereas almost all early educators and all managers were women. Most of the children were from families with a medium highest education level in the family. Fewer than one fourth of the early educators had received early education teacher education.

Table 6. *Demographics of the children, early educators, managers, preschool groups, and preschools.*

Variable	Mean (S.D.)	%
Children (n=586)		
Age	4.7 (0.9)	
Gender, girls		47
Highest education level in the family* %		
Low[1]		20
Medium[2]		43
High[3]		37
Early educators (n=379)		
Gender, women		97
Age, years	42.0 (11.6)	
Education level in early childhood education		
None		5
Vocational qualification		51
Bachelor of social services/social pedagogue		21
Early education teacher		22
Managers (n=53)		
Gender, women		100
Age, years	48.4 (7.7)	
Education level		
Bachelor of educational science		60
Other		40
Work experience as a manager, years	13.7 (11.8)	
Preschool groups (n=146)		
Number of children in the group	19 (5.0)	
Number of early educators in the group	3.2 (0.7)	
Preschools (n=58)		
Number of children	87 (32)	
Number of preschool groups	5.0 (1.8)	
Number of early educators	16.2 (6.0)	

*Highest education between mother and father
[1] Upper-secondary school, vocational school or lower
[2] College-level education or bachelor's degree
[3] Master's degree or higher

Table 7. *Descriptives of the mealtime environment on early educator-level (n=379).*

Variable	Mean (SD)	%
Personnel knowing the recommendation for children's fruit and vegetables consumption		23
Role modelling by the personnel		
Eat at the same table with the children		82
Eat the same lunch with the children every day		61
Eat the same lunch with the children 1-4 times a week		8
Does not eat the same lunch with the childen		31
Personnel rewarding with other food for eating vegetables (scale: 1 (never) – 5 (always))	1.9 (1.0)	
Personnel encouraging children to eat vegetables (scale: 1 (never) – 5 (always))	4.6 (0.5)	
Personnels' positive opinion of the preschool food (scale: 1 (totally disagree) – 5 (totally agree))	3.3 (0.9)	
Personnel agreeing that there is adequent amount of vegetables served at preschool (scale: 1 (totally disagree) – 5 (totally agree))	3.3 (1.3)	
Personnel stating that there is too much sugar in the preschool food		19

Tables 7-9 present the descriptive results of the mealtime environment variables from early educators' questionnaire (Table 7), contact person's questionnaire and observation (Table 8) and managers' questionnaire (Table 9).

Less than one fourth of the early educators knew that the intake recommendation for FV is at least 5 portions a day for children (Table 7). A majority of the early educators ate the same lunch as the children every day; rewarding children with other food for eating vegetables was rare (Table 8). A majority of the preschool groups had foods outside the menu available on birthdays (with or without restrictions on sugary foods). The children self-served vegetables and main course during lunch in approximately 30% of the groups.

Table 8. *Descriptives of the mealtime environment at the preschool group-level.*

Variable	%
Contact person's questionnaire n=146	
Food outside the menu on birthdays	
Not available	39
Available, but sugary foods restricted	30
Available, sugary foods not restricted	31
Children's participation in practical meal preparations, e.g. setting the table	
Never	19
1–5 times a year	14
At least 6 times a year	7
At least once a month	7
At least once a week	14
Lunchtime observations n=133	
Lunch situations where at least one early educator sat in all children's lunch tables	41
Vegetables serving style	
Ready-made portions	10
Personnel chooses and serves	21
Children choose and personnel serves	38
Children serve themselves	30
Main course serving style	
Ready-made portions	9
Personnel chooses and serves	21
Children choose and personnel serves	41
Children serve themselves	28

A minority of preschool managers reported a lack of resources as a barrier to healthy nutrition or cooperation challenges with the catering service (Table 9). One out of five indicated that they could influence the supply of FV in preschool meals, and most of them reported having less than half of the 18 listed food policies at most.

Table 9. *Descriptives of the mealtime environment at the preschool-level. Managers' questionnaire (n=58).*

Variable	%
Number of written food policies (0–18)	
4 or less	35
5–9	36
10 or more	29
Food education (0–3)[1]	
0	45
1	34
2 or 3	22
Perceived cooperation challenges with the catering service (0–3 challenges)	
No challenges	54
1 challenge	24
2 or 3 challenges	22
Lack of resources as barriers to healthy nutrition[2] (0–3)	
0 lacks	81
1–3 lacks	19
Concern about children's fruit and vegetable consumption (scale 2–10)	
5 or less	19
6	44
7 or more	36
Perceived influence over fruit and vegetable supply	
Yes	19
No	81
Kitchen type	
Cooking or heating kitchen	37
Distribution kitchen or other	63

[1] Training for the personnel, theme weeks at preschool, or Sapere

[2] Lack of planning time, materials or personnel

Table 10 presents the dietary intake of the children during preschool hours. The children received, on average, 55% of their daily energy intake from preschool food. The fibre density of children's food consumption at preschool was 3.0 g/MJ, and added sugar accounted for 4.4% of total dietary energy.

Table 10. *Children's daily dietary intake at preschool among those children who had eaten all preschool meals (breakfast, lunch and afternoon snack). n=586.*

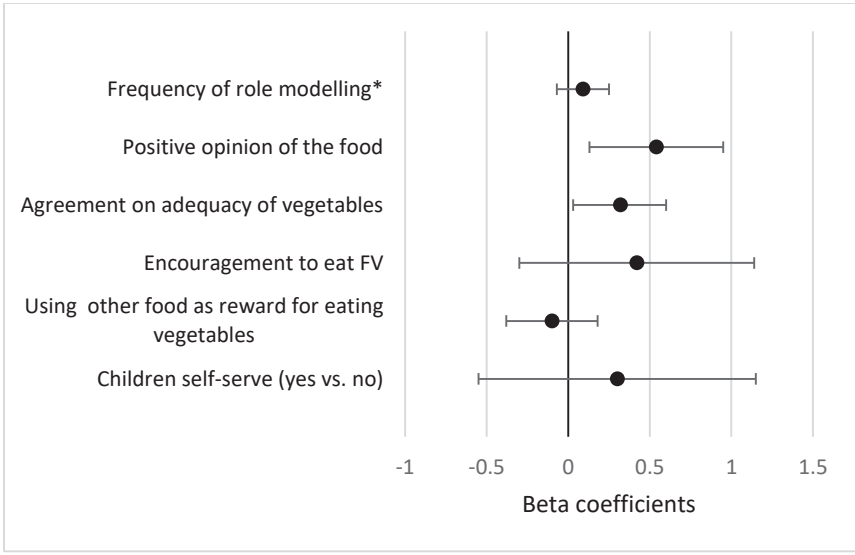
Nutrient	Mean (SD)
Energy (kJ)	3229 (910)
Energy (kcal)	771 (217)
% of daily energy intake in preschool	55.0 (10.5)
Fiber (g)	9.4 (3.1)
Fiber density (g/MJ)	3.0 (0.8)
Vegetables (g), raw and cooked	38.5 (28.3)
Fruits and berries* (% of those who had eaten)	65%
Fruits and berries* (g)	27.6 (33.8)
Added sugar (g)	9.8 (12.8)
Added sugar (E%)	4.4 (3.5)
Sucrose (g)	11.8 (8.1)
Sucrose (E%)	6.2 (3.7)
Proportion of added sugar from total sucrose intake (%)	64.3 (27.3)

Average number of days reported: 1.9 days per child, 1100 days in total
*Fresh fruits and fresh and frozen berries

5.2 ASSOCIATIONS BETWEEN MEALTIME ENVIRONMENT AND CHILDREN'S DIETARY INTAKE AT PRESCHOOL

5.2.1 MEALTIME PRACTICES, PERSONNELS' OPINIONS AND CHILDREN'S DIETARY INTAKE AT PRESCHOOL

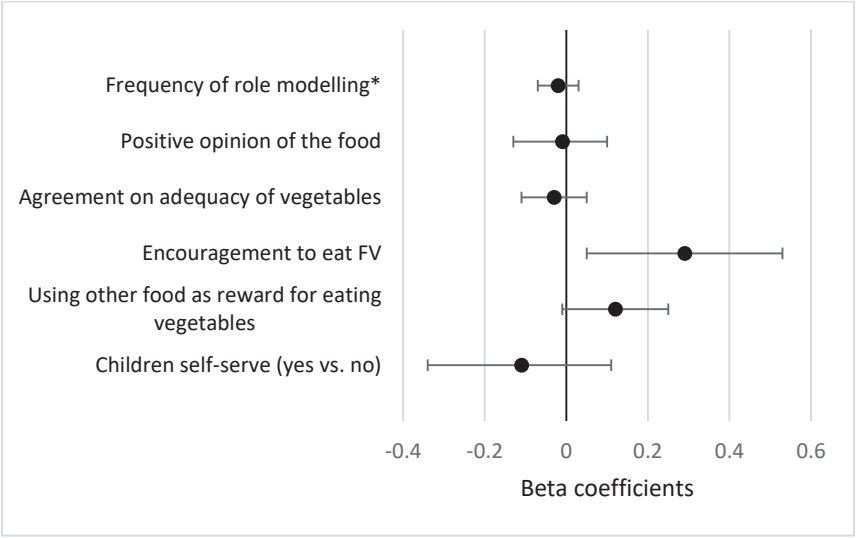
Figure 4 presents the adjusted associations between the early educators' mealtime practices and opinions and the children's vegetable consumption. The early educators' positive opinion of the food served (beta 0.54, 95% CI 0.13–0.95) and the agreement on the adequacy of vegetables served to the children (beta 0.32, 95% CI 0.03–0.60) were positively associated with with the children's vegetable consumption.



* frequency of eating the same food as the children among those early educators who reported usually eating at the same table with children. For those who did not eat at the same table, the frequency was set to zero.

Adjusted with the child's age, gender, energy intake and municipality.

Figure 4. Adjusted associations between early educators' mealtime practices and opinions and children's vegetable consumption at preschool (linear regression analyses, beta coefficients and 95% CIs). (n=488-571)



* frequency of eating the same food as the children among those early educators who reported usually eating at the same table with children. For those who did not eat at the same table, the frequency was set to zero.

Adjusted with the child's age, gender and municipality.

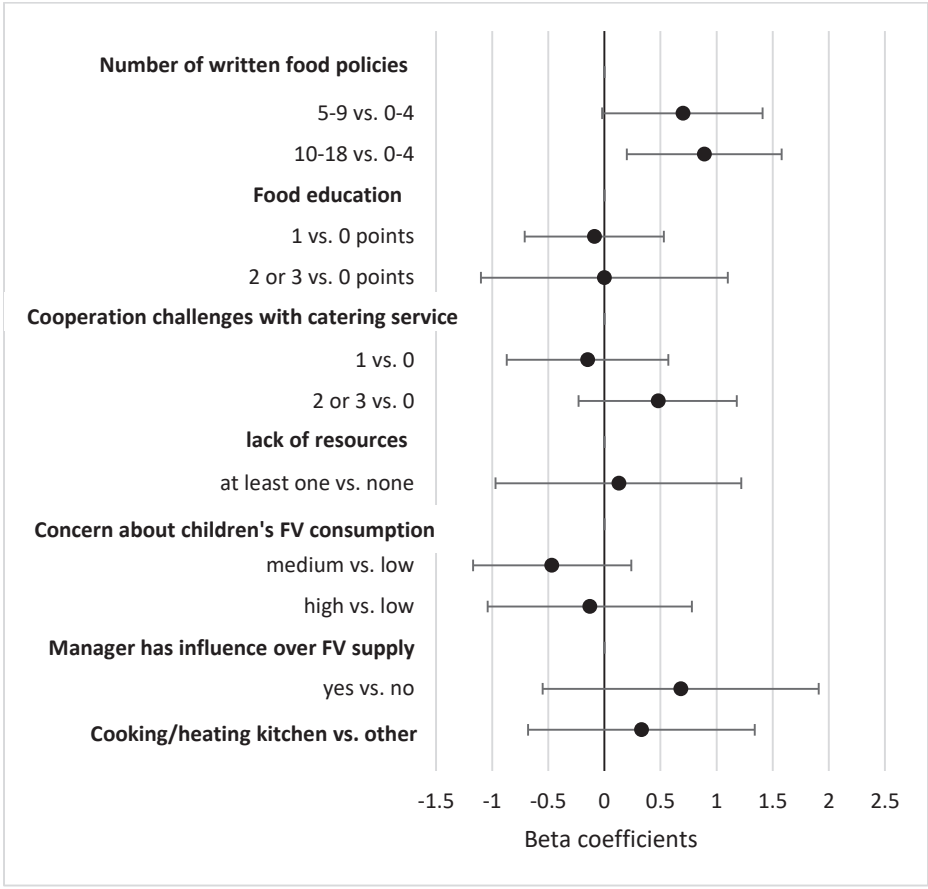
Figure 5. Adjusted associations between early educators' mealtime practices and opinions and children's fibre intake at preschool (linear regression analyses, beta coefficients and 95% CIs). (n=481-571)

Figure 5 shows the associations between the early educators' mealtime practices and opinions and the children's fibre intake. Encouragement to eat fruit and vegetables was associated with higher intake of fibre (beta 0.29, 95% CI 0.05–0.53). No other associations were found, although the association between using other food as a reward for eating vegetables and higher fibre intake was borderline significant.

Adjusted associations with the proportion of daily energy intake at preschool showed that early educators' frequency of role modelling (beta -0.81, 95% CI -1.60–-0.02) and positive opinion of the preschool food (beta -2.88, 95% CI -4.86–-0.89) were negatively associated with the proportion of energy intake at preschool (not shown in figures). Finally, in the unadjusted model, the early educators' opinion that preschool food contained excessive sugar was associated with higher added sugar intake, but none of the practices nor opinions were

associated with added sugar intake in the adjusted model (not shown in figures).

5.2.2 PRESCHOOL-LEVEL FACTORS AND CHILDREN'S DIETARY INTAKE AT PRESCHOOL

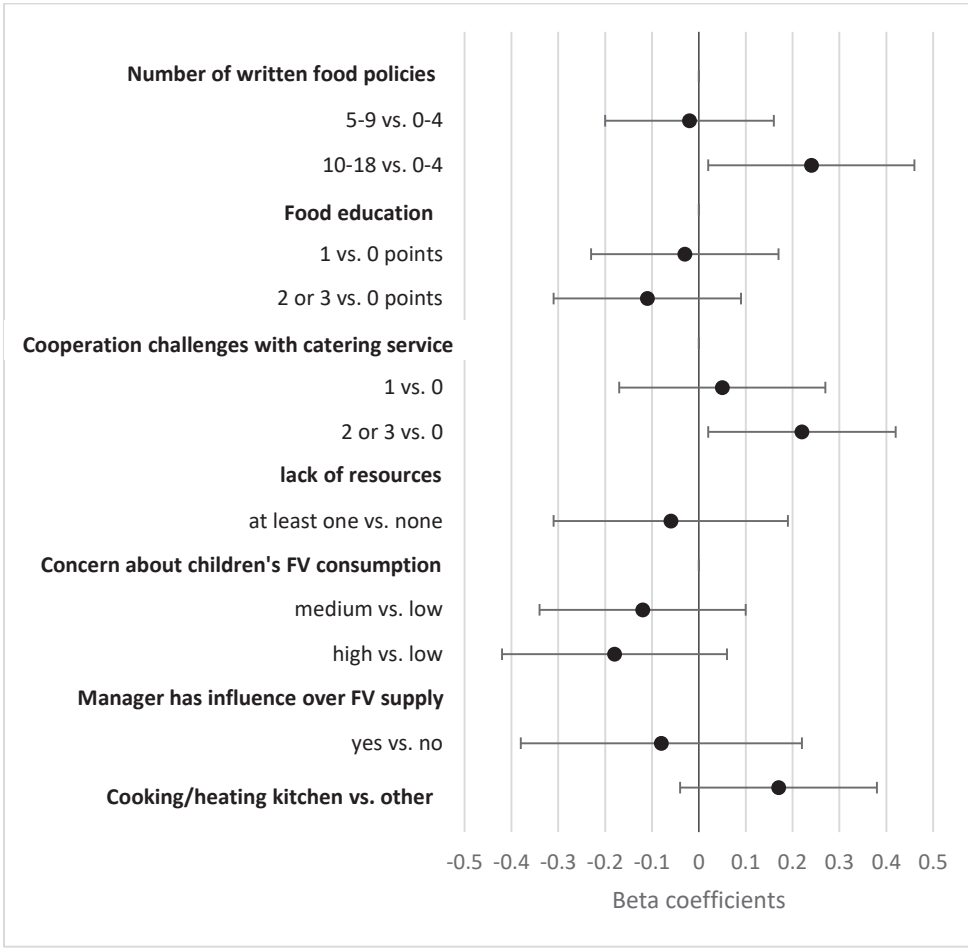


Adjusted with the child's age, gender and municipality.

Figure 6. Adjusted associations between preschool-level factors and children's vegetable consumption at preschool (multi-level linear regression, beta coefficients and 95% CIs). (n=528-531)

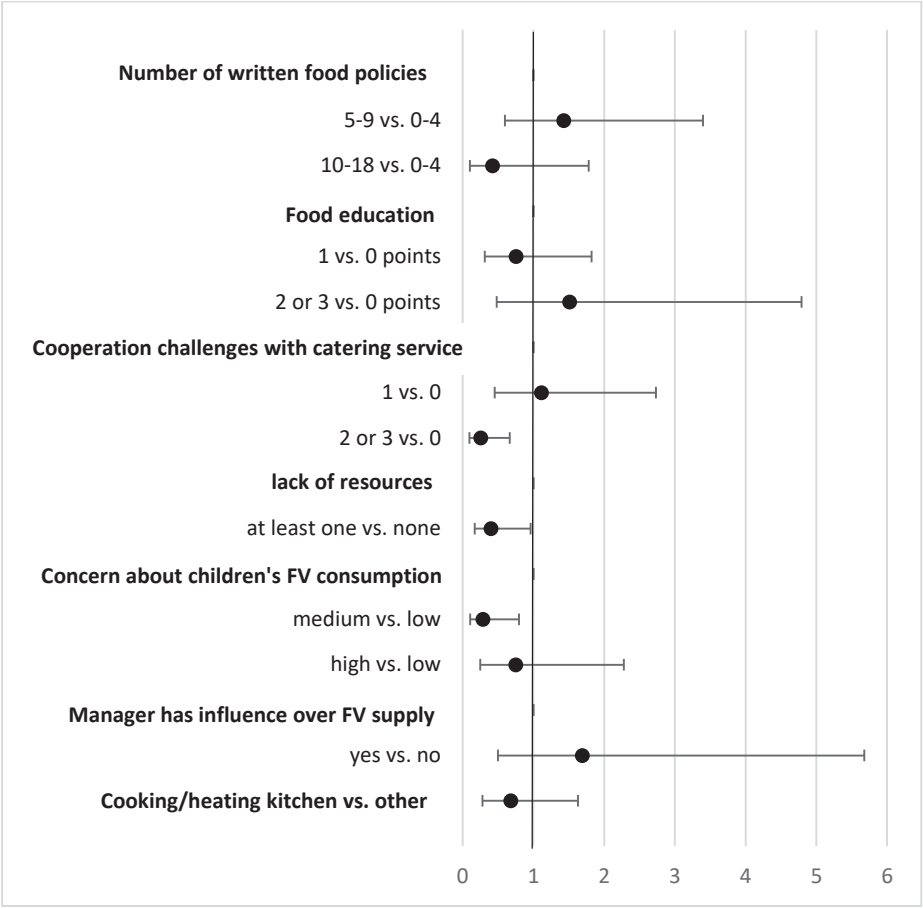
At the preschool-level, being in the highest tertile of the number of written food policies (at least 10 out of 18) in the preschool was associated with higher vegetable consumption

(beta coefficient 0.89, 95% CI 0.20–1.58) and a higher fibre intake (beta coefficient 0.24, 95% CI 0.02–0.46) compared to the lowest tertile of number of food policies (<5 policies) (Figures 6 and 7). Having 2 or 3 perceived cooperation challenges with the catering service compared to none was also associated with higher fibre intake (beta coefficient 0.22, 95% CI 0.03–0.42) and a lower likelihood of eating fruits and berries at preschool (OR 0.28, 95% CI 0.11–0.76) (Figures 7 and 8). A lack of resources as a barrier to healthy nutrition was also associated with a lower likelihood of children eating fruits and berries (OR 0.40, 95% CI 0.17–0.96), as well as medium concern about children's FV consumption vs. a low concern (OR 0.29, 95% CI 0.10–0.80). No other associations between preschool-level factors and children's dietary intake were found in the adjusted model.



Adjusted with child's age, gender and municipality.

Figure 7. Adjusted associations between preschool-level factors and children's fibre intake at preschool (multi-level linear regression, beta coefficients and 95% CIs). (n=528-531)



Adjusted with the child's age, gender and municipality.

Figure 8. Adjusted associations between preschool-level factors and children's fruit and berry consumption (yes vs. no) at preschool (multi-level logistic regression, ORs and 95% CIs). (n=528-531)

5.3 ASSOCIATIONS BETWEEN PRESCHOOL NEIGHBOURHOOD SOCIOECONOMIC STATUS AND PRESCHOOL MEALTIME PRACTICES

Table 11. *Associations between neighbourhood socioeconomic status and early educators' mealtime practices. Logistic regression, odds ratios (OR) and 95% confidence intervals (CI).*

	Model 1		Model 2	
	OR	**95% CI**	**OR**	**95% CI**
Neighbourhood SES	**Early educator eats the same lunch as the children (at least once a week vs. less often)** n=371			
Low	1		1	
Middle	1.58	(0.93–2.69)	0.88	(0.41–1.86)
High	**2.46**	**(1.42–4.24)**	1.07	(0.44–2.60)
Neighbourhood SES	**Early educator rewards the children with more popular food for eating vegetables (at least sometimes vs. rarely or never)** n=374			
Low	1		1	
Middle	1.79	(0.98–3.26)	1.6	(0.83–3.06)
High	**2.48**	**(1.40–4.41)**	**2.13**	**(1.12–4.07)**
Neighbourhood SES	**Children self-serve vegetables/salad (yes vs. no)** n=115			
Low	1		1	
Middle	1.72	(0.61–4.84)	1.24	(0.43–3.60)
High	2.64	(0.98–7.11)	1.52	(0.50–4.63)
Neighbourhood SES	**Foods outside the menu are available on birthdays (yes vs. no)** n=144			
Low	1		1	
Middle	0.57	(0.23–1.44)	1.71	(0.39–7.54)
High	**0.29**	**(0.12–0.71)**	0.72	(0.23–2.30)

Significant associations bolded.

Model 1: no adjustements

Model 2: adjusted with early educators' educational level and municipal policies on early educators' lunch prices and birthday treats.

Table 11 presents the associations between preschool neighbourhood SES and mealtime practices at preschools. In model 1, it was more likely that early educators ate the same lunch as the children and used food as a reward in high SES neighbourhood preschools compared to low SES neighbourhood preschools. Having foods outside the menu available on birthdays was also less likely in high SES neighbourhood preschools compared to low SES neighbourhood preschools. All associations except one were no longer significant after adjustments were made with the early educators' educational level and municipal policies on early educators' lunch prices and birthday treats. Only the association between preschool neighbourhood SES and rewarding with other food for eating vegetables remained significant.

5.3.1 MUNICIPAL POLICIES AND RELATED MEALTIME PRACTICES

Relating to the analyses on preschool neighborhood SES and mealtime practices at preschool groups, the prevalences of role modelling by the personnel and the availability of foods outside the menu at birthdays were checked according to the related municipal policies. Figure 9 shows the proportion of early educators' role modelling, i.e., eating the same lunch as the children, depending on the municipal policy on early educators' lunch prices. If all early educators received the preschool lunch at its taxable value, the proportion of those early educators who eat it was 83%, whereas if they did not, the proportion of eaters was 43%. All early educators received the lunch at its taxable value in five out of eight municipalities (not shown in figures).

Concerning birthday treats at preschools, 21% of the preschool groups still had foods outside the menu available on birthdays in municipalities where they were not allowed, whereas 90% of the groups had extra foods on birthdays in municipalities where they were allowed (Figure 10). The

children were not allowed to bring birthday treats to the preschool in three out of eight municipalities (not shown in figures).

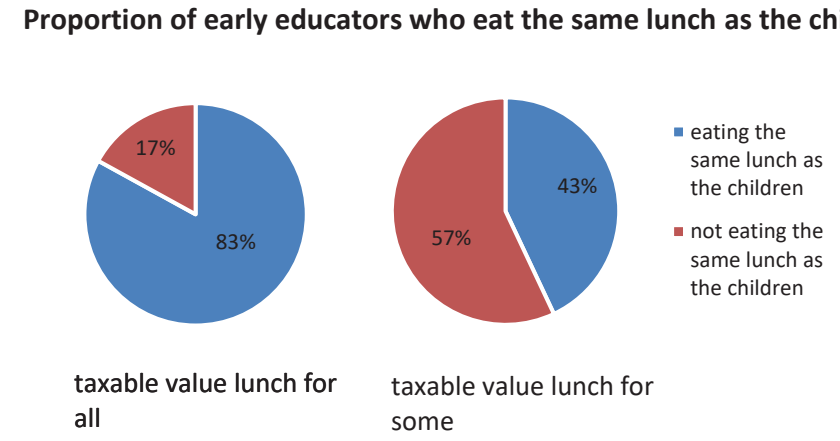


Figure 9. Proportion of early educators who eat the same lunch as the children according to the municipal policy on early educators' lunch prices. *** Chi^2-test p-value <0.001

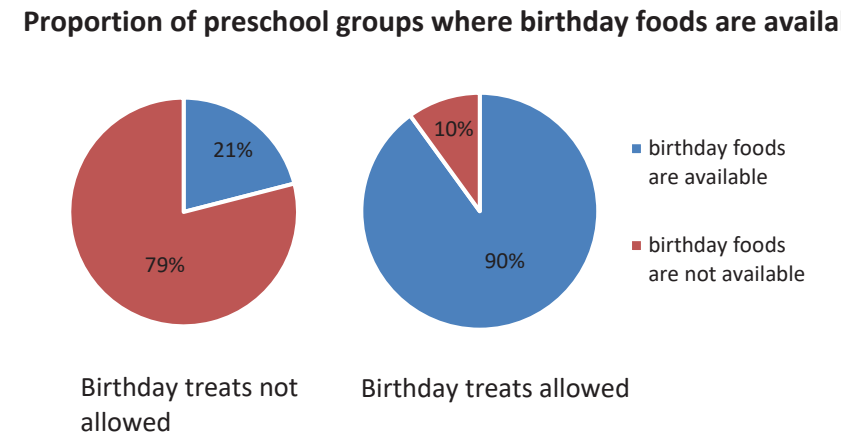


Figure 10. Proportion of preschool groups where foods outside the menu are available at birthdays according to the municipal policy on birthday treats. *** Chi^2-test p-value <0.001

6 DISCUSSION

This study aimed to examine the role of the preschool mealtime environment on children's dietary intake at preschool. Another aim of the study was to examine whether preschool neighbourhood SES associates with mealtime practices in preschool groups. Figure 11 presents a summary of the studied preschool variables and associations with children's dietary intake in a modified socioecological model. Chapter 6.1 discusses the associations in more detail. Several associations were found between different levels, both from the preschool group and preschool levels to children's dietary intake and between the municipality, preschool neighbourhood and preschool group levels. Regarding dietary intake, the children's energy intake at preschool was lower than the recommended two thirds of daily energy intake. Intake of added sugar was well below the maximum recommended intake of 10 E%, and consumption of vegetables, fruits and berries was modest.

Many of the studied variables and associations have not been examined previously, and in that sense this study can be seen as exploratory. Some of the found associations were counterintuitive and challenging to interpret. These findings may, however, offer new perspectives and hypotheses on the role of different mealtime practices and other mealtime environmental factors at preschools and provide grounds for new studies on the preschool environment and children's diets.

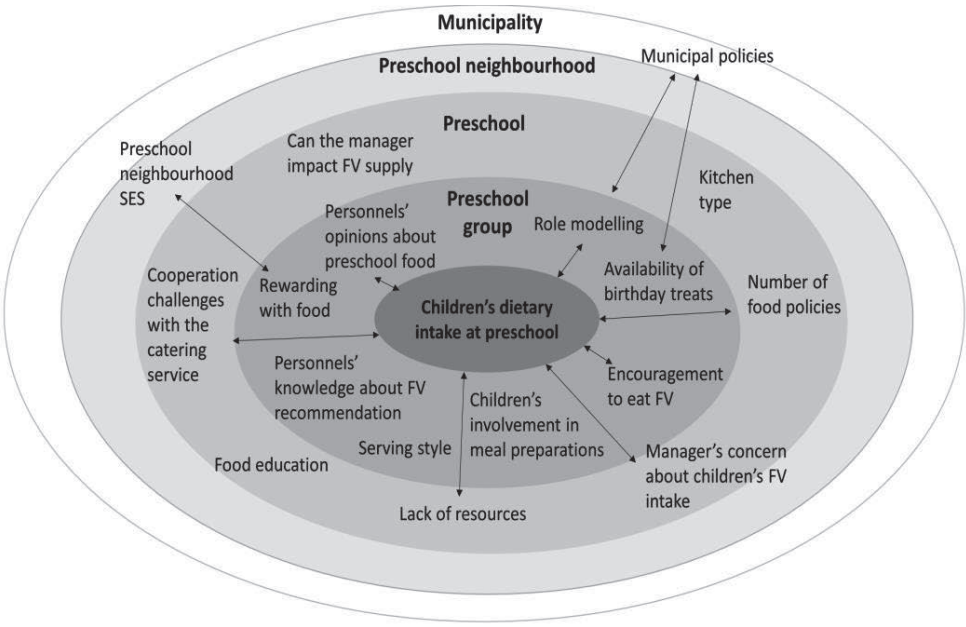


Figure 11. Socioecological model of the studied preschool mealtime environmental factors and children's dietary intake. Found associations marked with arrows.

6.1 MAIN RESULTS AND THEIR INTERPRETATIONS

6.1.1 CHILDREN'S DIETARY INTAKE AT PRESCHOOL

The dietary intake of the children at preschool was examined on behalf of vegetable consumption, fruits and berries consumption, fibre intake, added sugar intake and proportion of energy intake at preschool. Consumption of vegetables at preschool was, on average, 39 g a day, which is under one portion of the recommended amount of 5 portions (approximately 250 g) of vegetables, fruits and berries per day. Nevertheless, previous studies have usually reported quite similar or lower consumption of vegetables [25, 29, 31, 35, 42,

96], though the comparison is challenging because of the different units (portions, cups, grams) or different combinations of foods (combining vegetables and fruits) or only reporting consumption at lunch [31, 35, 42]. A relatively large proportion of children (35%) did not consume fresh fruits or fresh or frozen berries at all during the keeping of the food record. Among the children who had eaten fruits or berries, the consumption averaged 43 g a day, while in the total sample it was 28 g a day. The amount eaten among fruits and berries consumers is lower than in the Netherlands but approximately at a level similar to that in the US studies [25, 29], although the same comparison challenges apply here as in the case of vegetable consumption. In total, children ate, on average, 66 g of vegetables, fruits and berries a day at preschool, which is less than 1.5 portions. Considering that children should eat two thirds of their daily dietary intake while in full-time care [7], the recommended amount of fruit, berry and vegetable portions at preschool would be 3. Increasing the consumption of fruits, berries and vegetables would thus be important.

Fibre intake was 9 g and 3 g/MJ a day at preschool, which reaches the recommended 2-3 g/MJ for children. This was a positive finding. Ward et al. and Andreyeva et al. have reported fibre intake at lunch being under 3 g, and compared to those results, the intake level in Finland seems higher [31, 35]. The proportion of energy intake from the whole-day energy intake was 55%, which is lower than the recommended two thirds. Other studies have also reported a low energy intake at preschool [34]. The intake of added sugar was 4.4 E% which is well below the recommended maximum intake level of 10 E% and contributed to 64% of children's sucrose intake, which was 6.2 E%. The main sources of added sugar at preschool were fruit and berry soups, dairy-based desserts, and yoghurt [117]. The intake level of 4.4 E% is low compared to other studies, although other studies have mostly reported intake of sugary foods and drinks or sugar intake at lunch [25, 26, 29, 35].

Overall, concerning the studied dietary variables, children's dietary intake at preschool is relatively healthy, though

consumption of fruits, berries and vegetables should be increased. The total dietary intake at preschool and its contribution to the whole weekday dietary intake in the DAGIS study is reported elsewhere [117]. The dietary intake at Finnish preschools is close to the recommendations when compared to studies from other Western countries [25, 27, 29-31].

6.1.2 MEALTIME PRACTICES, PERSONNELS' OPINIONS AND CHILDREN'S FOOD INTAKE AT PRESCHOOL

The results of the relationship of mealtime practices and the personnels' opinions on children's dietary intake showed some interesting findings. When the personnel had a positive opinion about preschool food and agreed that there were enough vegetables served to children, the children ate more vegetables. Role modelling by the personnel and positive opinions about preschool food were also negatively associated with the proportion of energy intake at preschool. Lastly, encouragement to eat FV was associated with higher fibre intake. No other associations to children's dietary intake were found.

The results of role modelling by the personnel contradict previous findings, which show that role modelling is associated with higher intakes of fibre [43], energy, vegetables [42], or sugar/sweet snacks [25, 35]. It is speculated that role modelling associates with children eating more of whatever is served [35]. Our contradictory results challenge these findings and also create a challenge for interpretation. The result is unlikely due to higher consumption of vegetables, because vegetable consumption was adjusted for. The result also remained the same when examining absolute energy intake (data not shown). The quality of role modelling is one aspect to be considered. It is possible that haste or restlessness at mealtimes prevents early educators from providing positive role modelling examples for children. Among early educators, role modelling and positive opinion about the food correlated

positively; thus, negative role modelling caused by dislike of the food is not probable.

Similarly, the personnels' positive opinion about the food was associated with lower energy intake but also a higher consumption of vegetables among children. The rationale behind studying this relationship was that early educators' opinions of the food might show in the way they talk to children about the food; however, it can also be an indicator of the food's quality. The association with lower energy intake might be due to children not liking the food when the early educators like it. This could be supported by differences in children's and adults' taste preferences [118]. Yet, when checking the amount of food eaten in grams, there was no correlation with early educators' opinion of the preschool food (data not shown). There might be differences in the energy density of foods between preschools or municipalities, and early educators may prefer less energy-dense preschool food. This could lead to lower energy intake among children. The vegetable variable did not include vegetables in main dishes, which could cause variability in the foods' energy density.

The findings were positive that personnels' positive opinion about the preschool food and their agreement on the adequacy of vegetables served to children were associated with higher consumption of vegetables. The associations may reflect a higher amount and quality of vegetables served in these preschools, but the personnels' positive opinions can also encourage children to consume more vegetables. Previous studies on similar topics were not found.

Encouragement to eat FV was associated with higher fibre intake, whereas no association with vegetable consumption was found. Encouragement to eat new/less favourite foods have not been associated in previous studies with children's dietary intake [25, 31, 35, 42, 43]. One possible explanation for the found association is the role of high fibre rye crackers at preschool meals in Finland. Rye crackers are almost always served during lunch and also at other meals, and sometimes they are withheld until a child finishes/eats some of the other

parts of the meal, although this practice is not recommended. Rye crackers are a major single source of dietary fibre during preschool hours (accounting for 21% of fibre intake at preschool), while two thirds of all dietary fibre during preschool hours come from cereal foods, and less than one fifth come from vegetables, fruits and berries [117]. The found association may, thus, result from encouraging children to eat FV, which might include rewarding or blackmailing them with rye crackers. This is also supported by the borderline significant association between rewarding with other food for eating vegetables and higher fibre intake. Reverse causality is also possible: personnel might encourage fruit and vegetable consumption more in preschool groups where children eat a lot of rye crackers.

6.1.3 PRESCHOOL-LEVEL FACTORS AND CHILDREN'S DIETARY INTAKE AT PRESCHOOL

Being in the highest tertile of the number of preschool food policies was associated with children consuming more vegetables and having a higher fibre intake compared to the preschools that were in the lowest tertile of the number of food policies. Manager-reported cooperation challenges with the catering service were associated with both higher fibre intake and lower odds of children eating fruits and berries at preschool. A lack of resources and a medium level of concern about children's FV consumption were also associated with lower odds of eating fruits and berries. Other preschool-level factors, such as kitchen type or food education, were not associated with children's dietary intake.

Himberg-Sundet et al. [96] reported that having their own written guidelines on foods and beverages that are offered to children was associated with children eating more vegetables at preschool in Norway. Ritchie et al. [119] found that CACFP policy and state law changes concerning beverages offered to children at U.S. preschools brought about changes in drinks offered to children at U.S. preschools. These studies also show

the variations in the sources of policies and the extent to which they are enforced [23], as laws are naturally more binding than other policies. Finnish law on early childhood education and care includes relatively vague statements about food and nutrition at preschools. According to the law, children must be served food that fulfills their nutritional needs and their meals must be supervised [3]. More specific instructions are given in the national recommendations on preschool food, which contain both nutritional recommendations and recommendations on mealtime practices and the mealtime environment in general (referred to as food education) [7]. Nevertheless, the recommendations are not binding, and there is no national monitoring of their compliance. Municipalities can also have their own policies that directly or indirectly influence preschool mealtime practices, as was seen with the prevalence of role modelling by the personnel and having extra foods available at birthdays according to related municipal policies. Municipal requirements can also contradict national recommendations. Preschools can have their own policies in addition to those.

The content of and compliance with the food policies are worth consideration. The studied policies concerned foods and drinks served to children in Ritchie's [119] and Himberg-Sundet's [96] studies. Instead, in my study, the policies concerned mostly mealtime practices or other rules about eating and meals. No policies about foods served to children were examined, because preschool managers or personnel in Finland have very little influence on the foods served at preschool. The content of the studied policies and the compliance with them is not known in this study; thus, no speculations can be made about the mechanisms of how they contribute to children's dietary intake. It has been found that the existence of policies does not necessarily translate into intended mealtime practices among personnel [89], although policies are also found to be associated with the use of recommended practices [86, 88]. Lucas et al. [23] have also studied preschool and school food policies (about foods served

to children) in Sweden, UK and Australia, and they conclude that, while all of these countries have different meal systems in preschools, all of them would benefit from clear implementation of policies and national monitoring of their implementation.

Interesting associations were found between cooperation challenges with the catering service and children's dietary intake. A higher number of manager-reported challenges with the catering service was associated with higher fibre intake among children. This could be due to the main sources of dietary fibre, as already discussed in chapter 6.1.2. It can be a sign of children eating a lot of rye crackers, and it would be interesting to study further whether this is the case and whether the consumption of other parts of the meals differ by the number of challenges. A higher number of challenges was also associated with a smaller likelihood of children eating fruits and berries, which further raises the importance of studying this topic more, concerning for example the content of the challenges and whether there are differences in the served foods. No other studies have examined such associations, to my knowledge, but Byrd-Williams et al. [120] have assessed the prevalence of similar challenges with the catering service reported by preschool managers and early educators.

A lack of resources, which consisted of lack of planning time, materials or personnel as barriers to healthy nutrition, is associated with lower odds of children eating fruits and berries. Similar associations have not been studied before, to my knowledge. Surprisingly, a lack of resources did not correlate with the frequency of serving fruits and berries at preschool (data not shown), which could have explained the finding. A medium level of concern about children's FV consumption was also associated with lower odds of children eating fruits and berries. The result may be due to reverse causality.

6.1.4 NEIGHBOURHOOD SOCIOECONOMIC STATUS AND PRESCHOOL MEALTIME PRACTICES

The results of preschool neighbourhood SES and mealtime practices in preschool groups showed that associations were found in the crude model, but most of them were no longer significant in the model adjusted with early educators' educational levels and municipal policies on early educators' lunch prices and birthday treats at preschool. Only rewarding with food remained associated with higher SES neighbourhood preschools in the adjusted model.

Only two previous studies examined associations with preschool neighbourhood SES or area deprivation and their associations with preschool mealtime practices, to the best of my knowledge [24, 79]. Neelon et al. [79] found that some mealtime practices were closer to the recommendations in more deprived areas in England. My results also showed, surprisingly, that a not-recommended practice was more common in high SES neighbourhood preschools, despite finding two associations favouring high SES neighbourhoods in the unadjusted model. Gerritsen et al. [24] found no associations in New Zealand. Copeland et al. [93] have studied the proportion of low-income children in U.S. preschools and its relationship with preschool physical activity environment, thus a closely related topic. They found that preschools with more low-income children also had more restrictive (not-recommended) physical activity practices. Overall, these few studies show mixed results concerning the relationship between neighbourhood SES and preschool mealtime practices. Our study did not confirm the assumption that mealtime practices would be closer to the recommendations in high SES neighbourhood preschools, and it seems that municipal policies may rule out such differences. I will discuss this topic more in the next chapter.

Comparison of results with other countries is challenging, because, as shown in the case of Head Start and CACFP preschools in the USA, low-income children in some countries are more likely to attend preschools that are more heavily

regulated, implement more recommended mealtime practices, and serve more recommended foods [31, 76, 84, 88, 92]. Most children in all socioeconomic groups in Finland attend municipal (public) preschools [14, 121], and specific preschool programs for low SES children do not exist.

The role of the municipality

Our results show the importance of municipal policies on preschool practices in Finland, because, for example, the prevalence of early educators eating the same lunch as children varied greatly (83% vs. 43%) depending on whether or not all early educators in the municipality received the lunch at its taxable value. There was also considerable variation in whether or not extra foods were available at birthdays according to the municipal policy on bringing birthday treats to preschool. Other municipal policies not considered in this study may also affect mealtime practices at preschools.

There were significant differences between municipalities in the SES score of their preschool neighborhoods (data not shown). These differences can reflect true SES differences between municipalities [103], although our data only covered some neighbourhoods in the studied municipalities. The results also indicated that municipalities that had higher SES preschool neighborhoods also had policies that presumably lead to healthier food intake among children. We can only speculate on the reasons for such differences, but such municipal policies can reflect municipal (material and immaterial) resources invested in preschools and preschool meals as well as the values of the municipalities' voters and decisionmakers.

Municipalities in Finland are obligated to organise early childhood education and care services, including meals during the preschool day, for their inhabitants [3]. The municipalities can buy these services from other service producers, but the municipality is still responsible for the service corresponding to the quality requirements set in the law. The food recommendation for early childhood education and care have

formulated criteria for organising a tender competition for preschool catering services, and these criteria also include activities concerning the mealtime environment and cooperation with preschool personnel [7]. The municipality should also monitor and evaluate the criteria's fulfilment or otherwise monitor the quality of the food served and the mealtime environment. The extent to which this done in municipalities is unknown.

6.1.5 FINDINGS IN RELATION TO RECOMMENDATIONS ON PRESCHOOL MEALTIME PRACTICES

The Finnish recommendations on preschool food and the mealtime environment state that early educators should eat with the children as an example and encourage children to eat and try new foods [7]. Pressuring children to eat or using food as a reward is not recommended. Children should also self-serve. The US recommandations contain mostly the same recommended practices [54]. Other recommendations are also stated, such as talking about foods with children, but this study does not examine them.

Firstly, when considering the prevalence of the recommended practices, it is noteworthy that 31% of early educators did not eat the same food as the children and that children self-served in only 30% of the preschool groups, although all the studied preschool groups were groups of older children and no toddler groups were included. Encouragement to eat FV was common, and rewarding with food was quite rare, which are positive findings.

The associations found in this study only partly support the recommendations. Contrary to some previous studies, role modeling by personnel showed no beneficial associations with children's dietary intake. Family-style serving showed no associations with the studied dietary variables. Encouragement to eat FV showed an association with higher fibre intake, which is essentially a positive finding, even though high fibre intake in this context may reflect a high intake of cereal foods,

specifically rye crackers [117], and it can also be due to reverse causality. Rewarding with food was not associated with the studied dietary intake variables, although a borderline significant association to higher intake of fibre was found. This finding can also relate to the sources of dietary fibre in Finnish preschools and to the fact that rye crackers can be used as rewards. It is a positive finding that the personnels' positive opinion of the food is associated with higher vegetable intake and emphasises the importance of a positive mealtime atmosphere.

An important point to remember is that the recommendations are drawn as a result of expert opinions and some experimental studies, and they also serve child-developmental purposes other than healthy dietary intake, such as learning new skills and self-regulation [54, 55]. Thus, effects on dietary intake are not always even expected. The results of the other existing epidemiological studies on dietary intake only partly support the recommendations [25, 31, 35, 42, 43]. However, the number of studies of preschool mealtime practices and children's dietary intake is still low, and no clear conclusions can be made from them, partly because of the study designs, variation in the studied practices and dietary variables, and variation in the foods served to the children [25, 31, 35, 42, 43].

6.1.6 EARLY EDUCATORS AS PROFESSIONALS OF FOOD EDUCATION

The basic tool when planning preschool activities and curriculum in Finnish preschools is the municipalities' own preschool curriculum that is based on the national core curriculum issued by the Finnish National Agency for Education [122]. The national core curriculum was updated in 2016 (after this study's data collection), and this was the first time when supporting a healthy lifestyle was mentioned in the curriculum. The current core curriculum states that healthy

behaviours, including healthy food consumption, are valued and promoted [122]. There has also been an indication of food education, healthy eating, table manners or some other food-related matters gaining more attention in local curricula [123], which is a positive trend.

Ray et al. [113] have studied views of Finnish early educators about the facilitators of and barriers to healthy eating in Finnish preschools in a qualitative study within the DAGIS project. They found that early educators consider their role as role models and food educators important, and they also feel they are competent in those tasks [113]. Early educators also see the role of preschool food as important for children's overall diet. In contrast, early educators in a Swedish study felt incompetent acting as food educators [124]. Food education (here, all activities related to food and eating) given by early educators has been studied in a Finnish Master's thesis [97]. That thesis grouped different mealtime and other food-related practices into food education styles, the most common of which was an early educator-based style in which early eductors asked, instructed and encouraged children to do certain things. Child- or interaction-based styles were less common, though interaction and child involvement are stressed in the recommendations. According to a recent nationwide report on the quality of early childhoold education and care services, a large majority of preschool personnel stated that mealtimes are positive and unhurried, the mealtime practices used promote positive attitudes towards food among children, and that planned pedagogic activities occur at mealtimes [125]. Unfortunately, the use of the specific practices mentioned in the recommendations was not studied in the report. However, according to open comments on that study, mealtimes are sometimes restless, stressful and hurried, and there are opposite views among personnel about which practices are recommended and which not.

This study found that early educators have poor knowledge of the fruit and vegetable recommendation for children, which was also true of the nutrition knowledge of ethnically diverse

Head Start teachers in USA [85]. The education of early education teachers is generally valued as high-quality in Finland, but their studies do not usually include courses on child nutrition or food education. Additionally, the personnel in preschool groups consist of several members with different educational backgrounds. Based on these few studies and this thesis, Finnish early educators seem confident in their role as food educators, although some improvements could be made when assessing specific practices used. Additionally, inclusion of child nutrition and food education in all personnels' education could increase their knowledge of child nutrition and the recommended mealtime practices.

6.2 METHODOLOGICAL CONSIDERATIONS

6.2.1 THE DESIGN

The study was cross-sectional; thus, there is no possibility of verifying causal relationships from the findings. Inverse causality is also always possible in cross-sectional studies, and the results may also stem from an unknown confounder. Reverse causality is possible in sub-study I, as the children's dietary intake might affect some personnels' mealtime practices, especially encouragement, rewarding, or perhaps even opinions of the preschool food. It is also possible in sub-study II, though perhaps less likely, that children's dietary intake would have affected preschool-level factors, such as the number of written food policies or cooperation challenges between preschools and catering services. Instead, it is not meaningful to assume reverse causality between neighbourhood SES and mealtime practices at preschool in sub-study III. Except for a few small experimental studies [57, 58, 126], previous studies examining similar topics have also all been cross-sectional; thus, no conclusions can be drawn about the direction of the associations.

6.2.2 SAMPLE AND PARTICIPATION

The participation rate of children (families) was low in this study (24% of all invited participants), so participation biases are probable. In whole Finland, 44% of 35-39-year-olds have at least a Bachelor's degree [127], whereas in our study the proportion of such parents was 64%. Thus, participation bias according to education level is evident. Participation bias according to health interest is also probable, but as the study concerned only preschool food and preschool mealtime practices, these weaknesses are of smaller importance than when studying home-related factors. Still, socioeconomic differences in children's dietary intake exist [15]; thus, it is possible that the possibly healthier home dietary intake of the participating children compared to the general Finnish child population could have affected children's dietary intake at preschool. This could have led to a more positive picture of children's dietary intake at preschool than what it is in reality, concerning, e.g., vegetable consumption. Compared to other similar studies, the sample size was still relatively large [25, 31, 35, 42, 43].

The participation rate of preschools, however, was acceptable (56%) and that of early educators was good (79%). Selection bias on behalf of the preschools is also possible, as a manager's personal interest in children's health behaviours can have affected her decision to participate. It is also possible that the SES of the participants and of the preschool neighbourhoods would have been lower in those preschools (n=20) that were excluded because of the low consenting rate among the families. Unfortunately, we do not have preschool neighbourhood SES data for these preschools or all the preschools in the original sample (n=169). Despite the sample not being nationally representative, the participating municipalities were situated in different parts of Finland, and the sample included both urban and rural municipalities.

6.2.3 DIETARY ASSESSMENT DATA AND THE USED DIETARY INTAKE VARIABLES

The dietary assessment data were rigorous. A large effort was made to collect the recipes of all foods served and information on all food stuffs used at the preschool catering services. Validation of the Children's Food Picture Book used to assess children's portion sizes also revealed that early educators assess children's portion sizes with similar accuracy to the parents [105]. By contrast, a limitation was that, in some preschool groups, the early educators had to keep food records of several children simultaneously, which might have been burdensome and could have negatively affected the record keeping's accuracy. Additionally, the fact that the early educators reported both their mealtime practices and opinions and the children's food consumption can have caused reporting bias, although the questions concerning early educators' opinions and practices concerned their practices and opinions in general, not the days when they recorded children's food consumption. Nevertheless, the risk of such a bias was mitigated by using the means of all the early educators' responses in the same group for each practice and opinion.

There are also some limitations concerning the dietary intake variables used. One limitation is that the vegetable consumption variable did not include vegetables in main dishes. The reason for this was that at the time of the data analysis, it was not possible to get such data from the nutrient calculation software we used. Ingredient level data for the children's vegetable consumption will be reported later within the DAGIS study. However, vegetables are mainly eaten separately as salads or as raw vegetables in Finnish preschools. I recognise that including vegetables in main dishes could have given a moderately higher level of vegetable consumption and recommend using such a variable in the future.

In sub-study II, I had used a fruit consumption variable that included only consumption of fresh fruits, which was unfortunate, given the importance of berries in Finnish food culture. Surprisingly though, the consumption of fresh or

frozen berries as such was minimal at preschools (< 1 g a day). In the thesis, I reconducted the analyses of sub-study II with a variable including fresh fruits and fresh and frozen berries. The dichotomous fruits and berries consumption variable (eaters vs. non-eaters) was not optimal, but a linear intake variable could not be used, because more than one third of the children did not consume fruits or berries at preschool. The median frequency of serving fruits and berries was 3 times a week in the studied preschools (data not shown); thus, it is possible that no fruits or berries were served during the record keeping days for some children. As a result, the fruits and berries consumption variable might rather reflect the serving of fruits and berries and not children's willingness to eat them; thus, the results of their consumption should be cautiously interpreted.

Sub-studies I and II used partly different dietary variables. Fruit consumption was not included in sub-study I, because examining associations between early educators' mealtime practices and children's fruit consumption was not considered justified when fruit consumption might reflect the frequency of serving fruit at preschool, which early educators cannot influence. The proportion of children's energy intake during preschool hours was instead left out from sub-study II, because this variable was concidered ambivalent and not clearly an indicator of healthy dietary intake. Added sugar was also left out of sub-study II, because its intake was very low, and no associations were found in sub-study I.

6.2.4 DATA ON MEALTIME ENVIRONMENT

We studied early educators' mealtime practices and other mealtime environmental factors mainly from early educators' and preschool managers' self-reports. Though self-reports are easy to use and enable the gathering of data on a large number of participants, they also include response bias, such as social desirability bias [128, 129]. Few studies exist that have compared the results of self-reported and observed mealtime

practices of early educators. These studies conclude that discrepancies exist: self-reports tend to overestimate the use of recommended practices [71, 78]. Thus, self-reported data should be cautiously interpreted. We also conducted lunchtime observations at preschools, but the personnels' interactions with children was left out of the observations. Observation of interactions (such as encouragement or use of rewards) was considered methodologically too challenging and demanded too many research resources.

Our intention was to use validated and reliable questions whenever possible on the preschool personnels' and manager's questionnaires, and we translated and modified questions from several existing questionnaires [69, 70, 112, 114]. We developed questions in the DAGIS project based on focus groups with early educators when suitable questions for the Finnish context were lacking. Unfortunately, the validity and reliability of these questions is unknown.

There were some limitations in the questions on food policies. Many of them were worded in such a way that it is not possible to know the policy's content, only that there is a policy on a certain topic. Thus, the policies can also contradict the recommendations.

6.2.5 NEIGHBOURHOOD SOCIOECONOMIC STATUS VARIABLE

Sub-study III used a preschool neighbourhood SES variable. The hypothesis behind examining associations between neighbourhood SES and mealtime practices was that more qualified early educators might seek to work at preschools in high SES neighbourhoods, and, conversely, that the possibilities to put recommended practices into action could be better in high SES neighbourhood preschools due to the children's characteristics. Neighbourhood SES differences in children's problematic behaviour have been found in the US and Canadian studies [94, 95]. Alternatives to neighbourhood

SES would have been to use the SES of the children participating in DAGIS study or the proportion of children paying less than the maximum fee or no fee for their preschool attendance. However, since the participation rate was under 30%, and participation bias according to parental SES was probable, that alternative of using participant SES was abandonded. We were also unable to acquire data on the proportion of children with lower fees in the preschools. Additionally, preschool neighbourhood SES and the SES of the children in the preschool at a certain timepoint may differ from each other, even though children are usually placed in a preschool close to their home. Preschool neighbourhood SES might reflect the reputation and circumstances better and in a more stable way than children's SES at a certain timepoint.

6.3 IMPLICATIONS FOR FUTURE RESEARCH

This study found several associations between previously unexamined factors in preschool mealtime environments and children's dietary intake. The new finding that cooperation challenges between the preschool and the catering service associates with children's dietary intake is important and requires further investigation. Some of the found associations were also controversial according to previous findings. This especially concerns the findings of role modelling associating with lower energy intake.

Considering the small number of studies on similar topics and the findings of this study, further studies on mealtime environments and children's dietary intake at preschool are warranted. These studies should examine several aspects of the preschool mealtime environment and take the foods served into account. Cooperation between the catering service and preschool personnel should be more thoroughly studied, e.g., by qualitative methods and by both professional groups. More objective research methods, such as observation or video recordings with qualitative study designs, could also bring new

insights into the study of preschool meals and use of mealtime practices. Longitudinal studies and interventions are also very much needed to examine causal relationships between mealtime environment and dietary intake at preschool. Interventions specifically promoting the fulfillment of mealtime practice recommendations and examining the effects of such interventions on children's dietary intake and, for example, eating behaviour and attitudes towards food, are warranted. A broader examination of municipal policies in the Finnish context and their effects on preschool meals is also needed. Such studies should examine, for example, food-related policies, the content of contracts with catering services in municipalities, and the material and immaterial resources for preschool meals.

Systematic evaluation of preschools' food and mealtime environments would help invididual preschools and municipal stakeholders to evaluate and develop preschool meals and mealtime environments. Such data could also be used for scientific purposes and national monitoring. SkolmatSverige is a tool used in Sweden for schools to evaluate school meals from many perspectives [130]. This tool provides schools, municipalities and regions with data on the quality of their school meals. A Similar type of self-monitoring tool, which could be developed by educational and/or public health authorities, would also be very useful in Finland. The Finnish Education Evaluation Center conducts national surveys and evaluations of early childhood education and care services, and preschool mealtimes should also be evaluated from the viewpoint of the recommendations. Use of specific and as objective questions as possible is needed.

We used both previously validated and self-developed questions in this study's questionnaires. We aimed to develop questions that would suit the Finnish preschool context, because such questions were lacking. A methodology needs to be developed to assess preschool mealtime practices and perhaps other mealtime environments, as well. Validated questionnaires suitable for the Finnish context would benefit

not only researchers but also municipalities and other stakeholders evaluating preschools.

A key principal in ecological models is the interaction between and within the levels of different factors [17]. In this study, however, I have only examined single associations from one level at a time to another, which is common in studies examining the preschool environment and children's health behaviours [131]. However, as food intake is affected by a web of factors [16, 132], it would be important to apply a true ecological model and to study several factors at a time, interactions between and within the levels, as well as mediation from more distal level factors to children's dietary intake via closer level factors [131]. Such studies are lacking, perhaps, due to their complexity and the high demands on sample size, study design and methodology, but they would be needed to drive the field of study forward.

6.4 IMPLICATIONS FOR PRACTICE

This study found that several aspects of the mealtime environment were related to, and thus possibly can have an effect on, children's dietary intake at preschool. Though the preschool managers or personnel have little or no influence on the foods served at preschool, they can still shape the mealtime environment to best support children's healthy food consumption and eating behaviour. A good and comprehensive guide in this task is the new meal recommendation for early childhood education and care [7]. Although this study did not confirm positive associtions with dietary intake of some of the recommended mealtime practices, such as family-style serving style or role modelling by personnel, these results do not change the position of these practices as important recommended mealtime practices at preschools.

Some of this study's results can have practical implications at preschools. The finding that the personnels' opinion of the food relates to children's dietary intake raises a question about whether and how these opinions show and are reflected among

children. Positive attitudes towards the food are important and might help to create a positive atmosphere at mealtimes, which is also considered important in the recommendation [7]. Associations found between manager-reported cooperation challenges with catering services and the children's dietary intake also calls for attention. Cooperation and communication between the catering service and the preschools should be paid attention to by the stakeholders and also by the municipalities, as they draw up the contracts with the catering services and define the content of their services. The findings on fibre intake and, most importantly, the sources of fibre, raise questions about the role of rye crackers or other breads at preschool meals. Discussion is warranted within preschool groups about common practices regarding encouragement and rewards at mealtimes and, additionally, the children's right to eat all parts of the meal.

The results also showed that municipal policies and decisions can affect the preschool mealtime environment, perhaps also in ways not originally intended. Thorough consideration of the effects of municipal policies on preschool meal environments and fulfilment of the meal recommendations is needed when policies are made. In Finland, the municipality is a central operator regarding preschool meals, concerning both the foods served and the mealtime environment, of which the municipal decisionmakers should be aware.

6.5 CONCLUSIONS

This study is among the few studies that have examined associations of mealtime practices, other mealtime environmental factors and children's dietary intake at preschool. It was also the first study overall to examine the mealtime environment's association with children's dietary intake in Finnish preschools. The Finnish context differs from other countries where similar studies have been conducted with the large majority of children attending municipal

preschools that serve uniform and relatively healthy meals to all [41, 117]. Additionally, this study examined associations between preschool neighbourhood SES and mealtime practices at preschools.

This study found several mealtime environmental factors, some of them being examined for the first time, that were related to children's dietary intake at preschool. At the preschool group level, the personnels' positive opinions about preschool food were associated with higher consumption of vegetables among children. By contrast, the personnel eating the same food as children and the personnels' positive opinion about preschool food was associated with a smaller proportion of daily energy intake at preschool. Encouragement to eat FV was associated with higher intake of fibre. When considering preschool-level factors, children consumed more vegetables and had a higher fibre intake in preschools belonging to the highest tertile of the number of food policies compared to the lowest tertile. Additionally, manager-reported cooperation challenges with their catering service was associated with both higher fibre intake and lower odds of children eating fruits and berries at preschool. Lack of resources (personnel, materials, planning time) was also associated with lower odds of children eating fruits and berries. According to these results, both preschools and municipalities should pay attention to the cooperation between catering services and preschools, and to food policies, role modelling, and the personnels' opinions on preschool food. Further studies with different study designs on these topics are needed.

This study also examined whether preschool neighbourhood socioeconomic status is associated with mealtime practices used in preschool groups. Before adjustments, some recommended practices were associated with high SES neighborhood preschools, but after adjusting with municipal policies, these associations were no longer significant. Thus, municipal policies are probably more important in determining preschool mealtime practices than a preschool neighbourhood's SES. Broader examinations of

municipal decisions and policies and their associations with preschool mealtime practices and children's dietary intake are needed.

Overall, this study showed that many factors in the preschool mealtime environment, other than food availability, may determine children's food consumption at preschool. Food eaten at preschool forms a significant part of young children's diet, and together with food eaten at home, it can have long-term effects on eating habits later in life [9, 19]. Preschool meals and mealtime environment thus deserve attention and investment from municipal stakeholders, preschool personnel and parents, and researchers. With a well-organised mealtime environment and healthy foods served, preschool could have an important and long-lasting, positive effect on children's eating habits, dietary intake, and health.

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